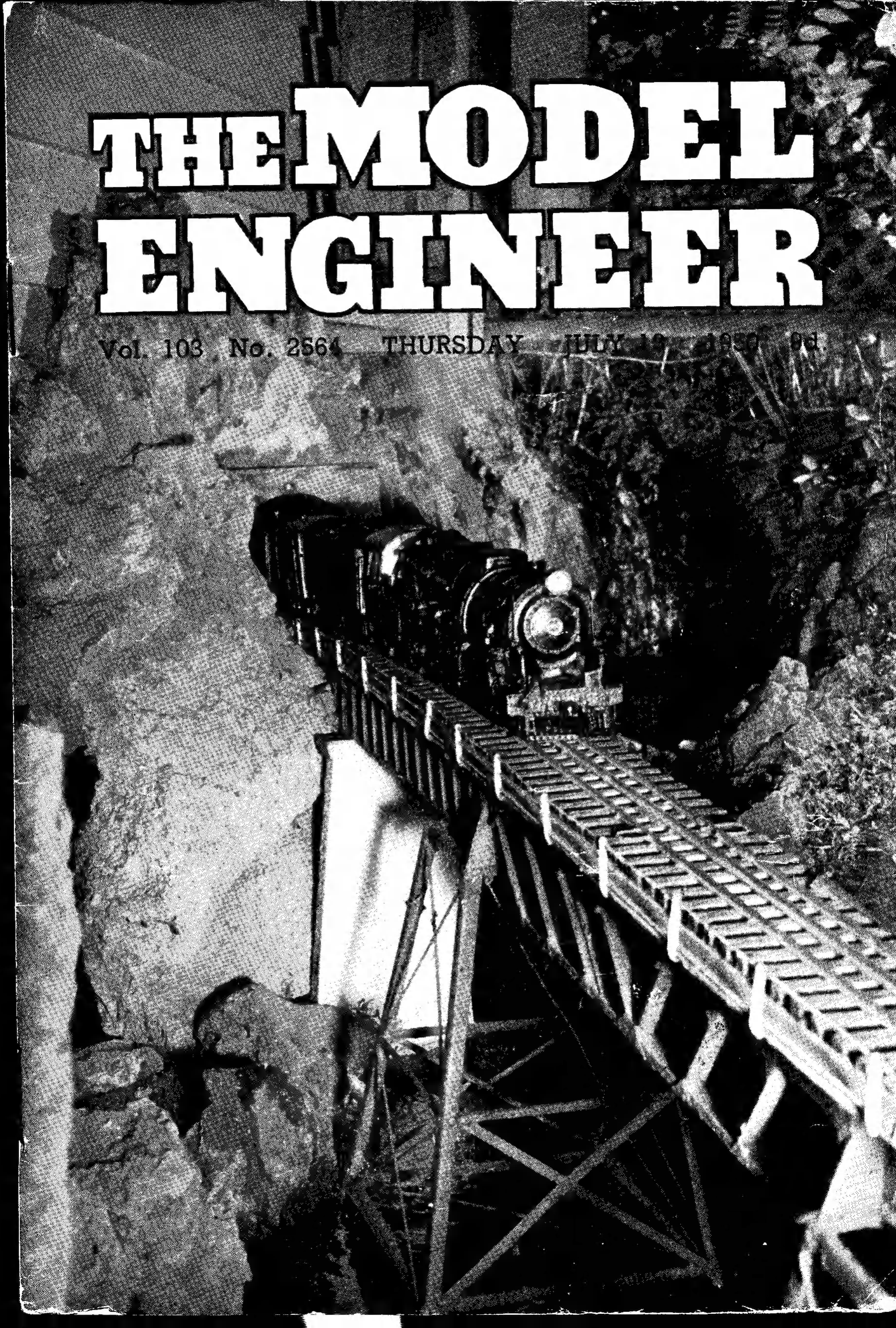
THE MODEL ENGINEER

Vol. 103 No. 2564 THURSDAY JULY 13 1950 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

13TH JULY 1950 VOL. 103 NO. 2564

SMOKE RINGS

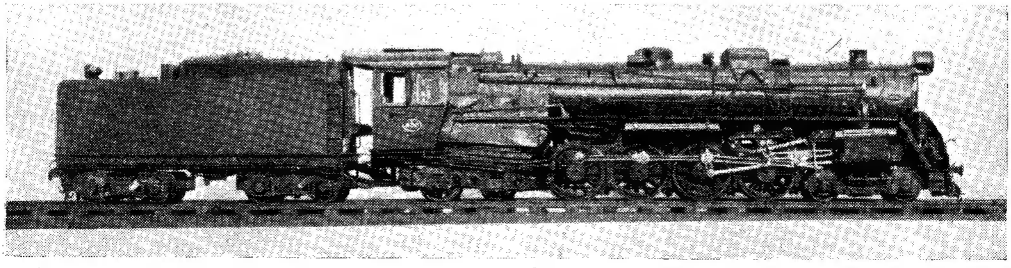
Our Cover Picture

● THE PHOTOGRAPH reproduced on our cover, this week, has come all the way from New Zealand. It is a scene on the Gauge " 1 " outdoor model railway belonging to 76-year-old Frank Roberts of Auckland, and is reproduced by courtesy of the *Auckland Star*. Mr. Roberts is a retired railwayman, and it seems that he just lives for small locomotives ; he has sent us a fine batch of photographs. They show that he is a first-class craftsman with, not only a very keen eye for detail, but a remarkable skill in making it in miniature ; for his models are actual miniature portraits of their prototypes. Some are electrically propelled and others are proper steamers ; one of the latter is seen in our cover picture, and is a faithful replica of the N.Z.R. K.900, 4-8-4 type engine. Another view of this splendid little model is reproduced below.

The gauge is $1\frac{3}{4}$-in., scale $\frac{1}{2}$ in. to the ft., since the gauge of the N.Z. Railways is 3 ft. 6 in. We are sure that our readers will enjoy studying the perfection of detail.

An " M.E." Exhibition Prospect

● THE TIME for the " M.E." Exhibition is, once more, drawing near, and we have little doubt that the eager anticipation of readers everywhere is increasing daily. One of the questions which occurs to many of us in the



pre-exhibition weeks is: Will there be any novelties on view this year? We think we may safely give an affirmative answer, so far as the forthcoming show is concerned; and, moreover, most of the novelties will be not merely of passing interest, but of practical use to model engineers and others who are keen to know the latest developments in technical and scientific subjects.

For example, there will be a stand illustrating "The Forge at Work," where all kinds of problems concerning metal work can be discussed and demonstrated. The blacksmith, Mr. Ibbotson, is a member of the National Master Farriers, Blacksmiths and Agricultural Engineers' Association. More details of this stand will be given later, in our annual "What to see at the Exhibition" article.

There will be demonstrations of wood-turning by experts from High Wycombe, the traditional home of this craft, and some of them will show the use of the bodger's, or "pole" lathe, an instrument which is rapidly disappearing from the country districts.

The 500-c.c. Car Club will have a stand on which demonstrations will show how a motor engineer can construct these fine little racing cars which have proved so successful in foreign countries.

The Department of Scientific and Industrial Research will have some very interesting exhibits on view; they will include: A calorimeter model building; a supersonic wind tunnel; a Tower of London micrometer; molecular models, and a wax hull of the type used for testing displacement, stability and other problems in hull design. All these will be on loan from the National Physical Laboratory at Teddington.

We understand that Mr. J. Fournereau, the well-known French model railway engineer, will be visiting the exhibition with his two sons, and will display some French models.

All this, in addition to the Competition, Club and Trade stands, should make this year's show a memorable one.

Another Public Park Track

● MR. TOM BANKS, hon. secretary of the Wigan and District Model Engineering Society informs us that the society's new track situated in Haigh Park, on the outskirts of Wigan, will be officially opened on Saturday, July 22nd, at 3.0 p.m. The track will take 2½-in. and 3½-in. gauge locomotives, and we understand that it is in an unusually beautiful setting, since the site was, at one time, part of the grounds of Haigh Hall, which, until recently, was the home of the Earl of Crawford and Balcarres. We hope to hear more about this latest addition to society tracks after it has begun "regular service"; meanwhile, we hope it will meet with all possible success.

An Old Beam Engine

● ANENT OUR recent reference to two old beam engines in Glasgow. Mr. James H. Farr, hon. secretary of the Edinburgh Society of Model Engineers has written to inform us that the members of that society recently spent an enjoyable and instructive afternoon, in spite of inclement weather, inspecting the Cornish pumping engine at the Prestongrange Colliery. This colliery was taken over by the Summerlee Iron Co. in 1895, when the Cornish pump was the only means of raising water to the surface.

The pump was built by Harvey & Co., of Hayle, Cornwall, and according to local residents, was shipped in parts to Prestongrange. Mr. Farr has kindly sent us a roneoed leaflet which gives much interesting information about the history of this pump which has met with one or two accidents, calling for some ingenious and difficult repairs, during its existence; but it is still working. Its dimensions are impressive: The steam cylinder is 70 in. diameter with a stroke of 12 ft., and the pump rams have a stroke of 10 ft. The main pumps consist of two 28-in. force pumps, one at the Great Seam level and one about midway between that and the surface, raising the water in two stages. At the Beggar level, below the Great Seam, is another pump, 17 in. diameter, which pumps to the Great Seam lodgement. The pump barrels rest on cast-iron beams needled into the shaft sides; the rams are fitted with crossheads and side-rods to enable the pump-rods to pass the barrels. The Oregon pine pump-rods are 23 in. square from the surface to to the top lift-pump, 18 in. square from that to the Great Seam, then 12 in. square to the Beggar level. The total weight of the pump-rods, rams, crossheads and side-rods is about 105 tons.

The beam measures 33 ft. long, 6 ft. 4 in. deep at the centre, and the average thickness is 5 in. The fulcrum is 18 ft. from the steam end and 15 ft. from the pump-rod end, the total weight being about 30 tons.

The average speed is about 3½ strokes per minute, which, allowing an efficiency of 70 per cent., would deliver about 650 gallons per minute.

It is evidently an impressive engine, a relic of the days when power was obtained through sheer size.

Contact Wanted

● WE HAVE just experienced one of those curious happenings which sometimes occur and add a little variety to our normal routine. A week or two ago, our Publishing Dept. received a letter from a Mr. J. P. Chisholm; it was written from the P.O. Mess, R.N.A.S., Abbotsinch, and it was dated 12th November, 1947. Where it had been in the meantime is, of course, purely a matter for conjecture; but our Publishing Dept. took a chance and replied to the address given. That letter has now been returned marked "Not Known."

If this paragraph should happen to catch Mr. Chisholm's eye, we would be glad if he would communicate with us again, as our Publishing Dept is naturally anxious to get into touch with him.

Apologium

● WE HAVE been advised that the lower illustration on page 297 of our issue of September 1st, 1949, was reproduced from a photograph originally taken by Mr. J. P. Mullett, of Berkhamsted. Through some misunderstanding, it was reproduced without acknowledgement, and we apologise to Mr. Mullett for any inconvenience caused.

A Model Gauge "1" Truck

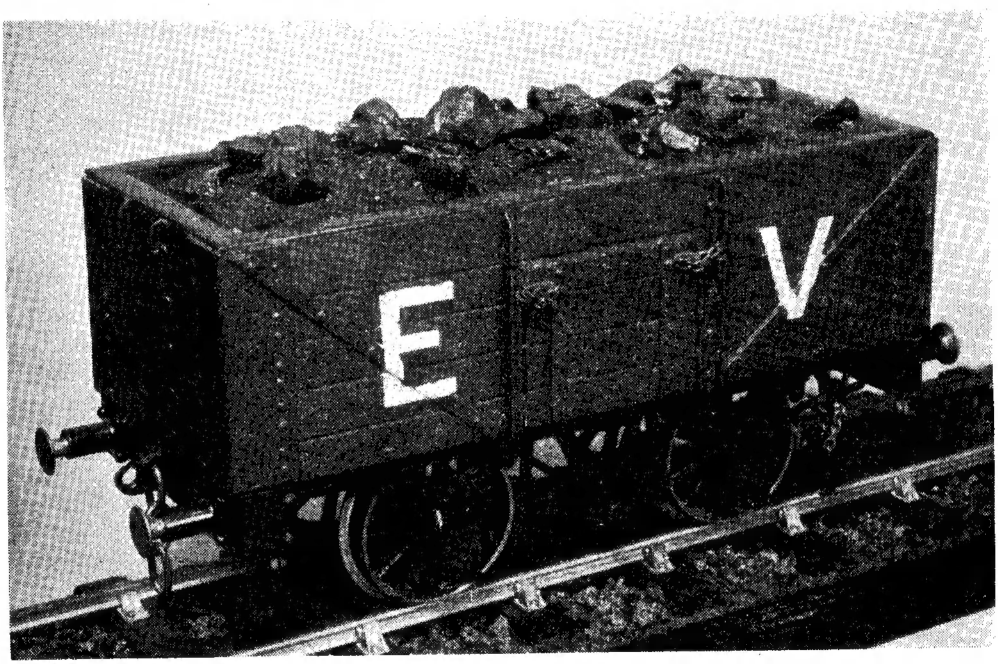
by J. E. Jane

HAVING recently completed an " L.B.S.C."-type gauge " 1 " " Juliet," it was not long before the possibilities of some rolling stock became the subject of my thoughts. Hence, this 10-ton truck, the first of the few which will serve to make up what I hope will be, in the future, a small garden railway. There is nothing startling about the construction as, like " Little Juliet," it was made up from odds and ends of material lying at hand.

The design is not of any particular make, and is merely the result of a combination of details, which, when sorted out, produced a fairly accurate appearance. These details, by the way, I managed to obtain by paying a few visits to the firm's goods yard, armed with a notebook and pencil. (Not forgetting the fact that I was nearly had up by the work's police for " loitering with intent.")

Although there was a time in the past, when I actually worked amongst wagons of all types, I was rather startled, upon closer inspection, to discover that the ordinary or common or garden truck has far more to it than is generally noticed by the layman. For example, the different types of buffers, axle boxes, brakes, etc., not to mention such details as the riveting, or bolting the planks to the braces and cover angles. However, there is always a " means to an end," and after spending a few evenings at my drawing bench on my notes and figures, some order was finally obtained out of the chaos.

Now, to put it briefly, I did not draw the job up in the usual sense of the word. Free-hand sketches were made of each section, and the necessary measurements added. As for the building; no direct sequence was adhered to. I built the particular part that struck my fancy at the time. In any case, there were periods when I was temporarily " hung up " for certain bits, and as I generally hate twiddling my thumbs, I just attacked another section instead.



The model truck complete

Despite the somewhat general appearance, there are some aspects which nevertheless compare favourably with the prototype. For example, the buffers are sprung, likewise the draw hooks, and the brakes actually work. On the other hand, such details as the doors, main springs, axle boxes, etc. are dummies, which only look something like the real thing. The wheels, although of strong make, are not quite of the right pattern, and were the only kind that could be obtained ready-made to suit the job. Even at that, they had to be " doctored " somewhat before fitting. It will be noticed that the wheel-

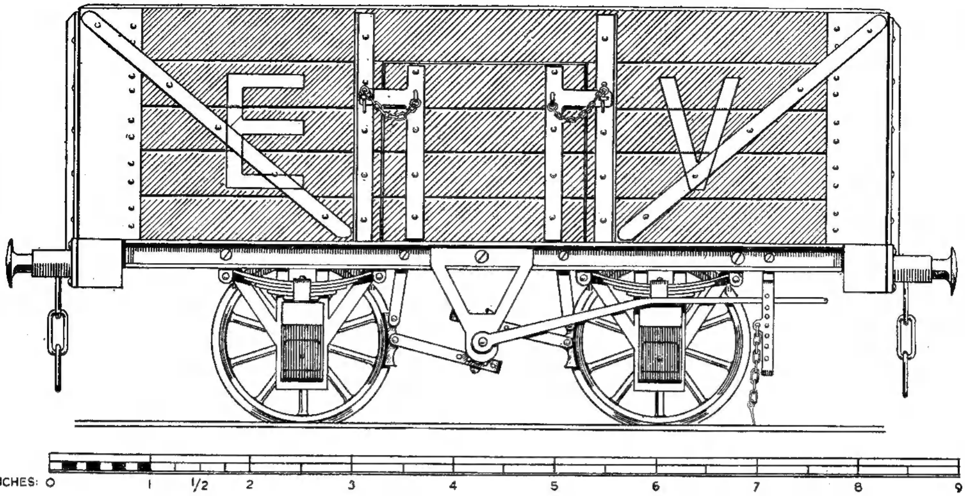
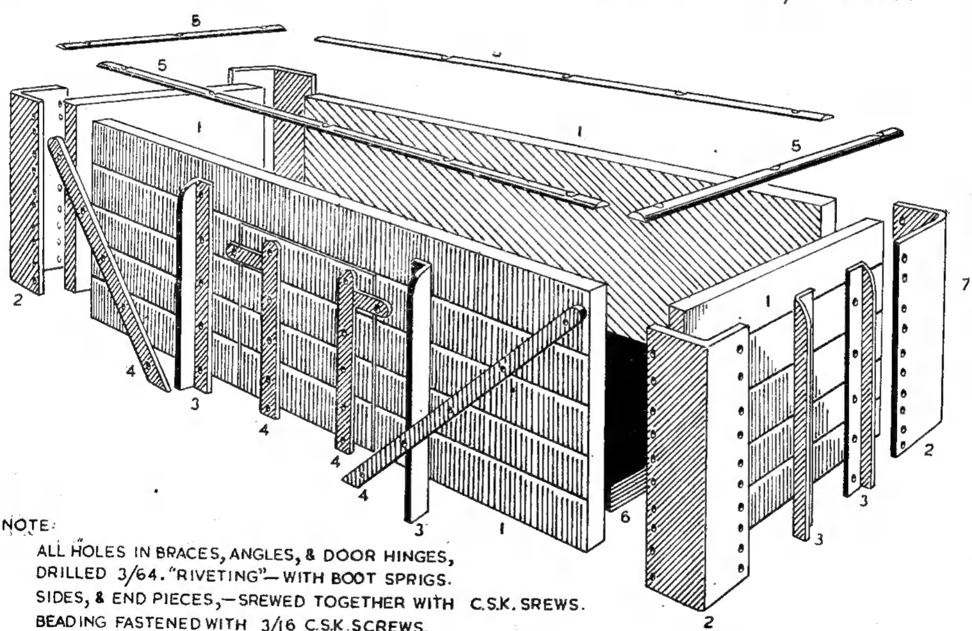


Fig. 1. *Side elevation of a model gauge "1" 10-ton truck*

1. SIDES & ENDS MADE FROM 1/4" PLYWOOD: WITH PLANKING "SCORED"
2. CORNER ANGLES MADE FROM 22 G SHEET IRON
3. VERTICAL BRACES :- 3/16" ANGLE BRASS
4. DIAGNAL BRACES MADE FROM 1/8" x 20 G. STRIP BRASS.
5. BEADING FILE TO HALF ROUND BEVEL FROM 1/8" THICK ALUMINIUM STRIPS.
6. FLOOR MADE FROM 3/8" PLYWOOD.



NOTE:
ALL HOLES IN BRACES, ANGLES, & DOOR HINGES, DRILLED 3/64. "RIVETING"—WITH BOOT SPRIGS.
SIDES, & END PIECES,—SREWED TOGETHER WITH C.S.K. SREWS.
BEADING FASTENED WITH 3/16 C.S.K. SCREWS.
FLOOR IS INSET. & SCREWED.
THE COMPLETE UNIT IS FIXED TO THE CHASSIS BY MEANS OF C.S.K. SCREWS INSERTED THRO' HOLES DRILLED IN CROSS SECTIONS.

Fig. 2. *Exploded view of the model truck*

base is shorter than normal ; this is to facilitate running on sharp curves, associated with a small layout. The markings, by the way, stand for "Ebbw Vale," and denote Ebbw Vale, Steel, Iron and Coal Company (although this Company no longer exists, being replaced by Richard Thomas & Company, I have noticed that the "E.V." markings are still used. I imagine, however, that by this time this denotes the district only).

and the diagonals and door hinges from $\frac{1}{8}$ in. wide by 1/32 in. brass strip. The beading had to be filed from strips of aluminium to the necessary size and bevelled to the required form. All the braces were fastened into position with ordinary " boot sprigs " to imitate riveting

The Chassis. Fig. 3

The longitudinals were made from $\frac{1}{4}$-in. channel brass, strengthened in the middle with

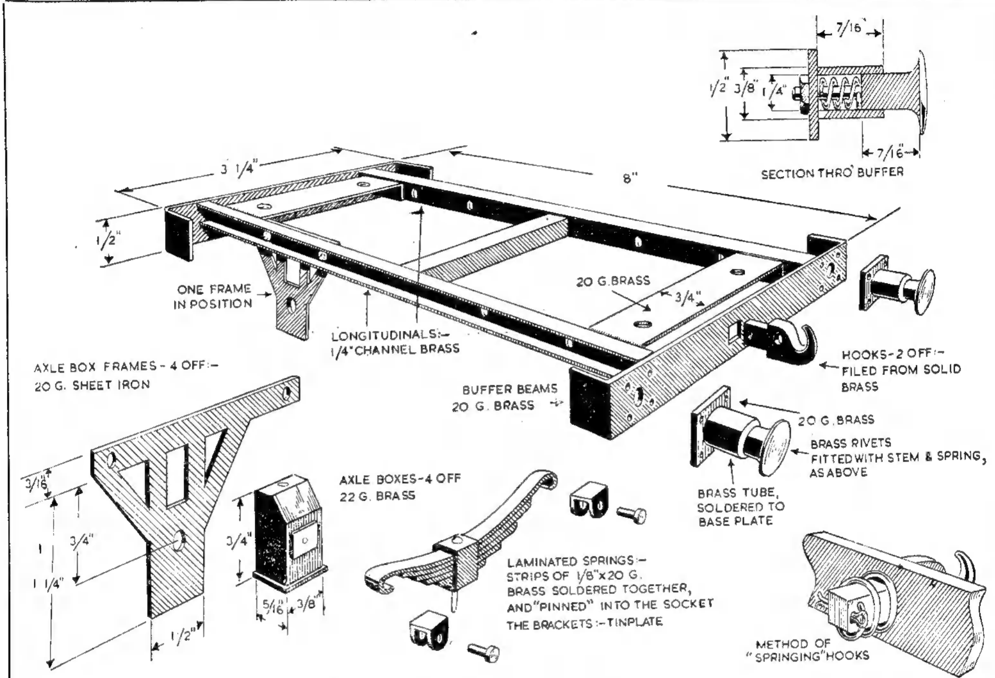


Fig. 3. The chassis assembly

The coal is real, and to obtain a realistic effect, I simply carved up a piece of wood to fit inside, generously coated it with glue, and threw on a handful of " broken up " mixture. It is not a fixture, and if necessary, it can be lifted out to make way for other " cargo."

Now to the construction. The drawings should show fairly well the general " build up " of the model. So, in the following remarks I shall only endeavour to describe briefly the material used, with possibly a word or two on the . . . . I would like also to draw attention to the fact that, in the main, the fittings are a little over scale size, and are made more robust, in order to counteract possible heavy travelling.

The Wagon Portion and Fittings. Fig. 1 & 2

The body was made up in the form of a box, from $\frac{1}{4}$-in. plywood, the floor consisting of a piece of $\frac{3}{8}$-in. plywood inset. The planking was scored on with the aid of a straight-edge. The corner angles were fashioned from 22-g. sheet iron, the vertical braces from $\frac{3}{16}$-in. brass, a cross-section of the same material, and at each end with strips of brass 1-in. wide by 1/32 in., soldered into position. The buffer beams were fashioned from 20-g. brass strip, and are soldered to the longitudinals. The draw-hooks were filed up from pieces of brass $\frac{1}{8}$ in. thick. The buffers were improvised from large copper rivets. Each had holes drilled into the stem, into which were inserted short lengths of $\frac{1}{16}$ in. diameter brass rod. These protrude through the base-plates, and are bolted into position, thereby holdlng the buffer in the socket against the spring. The sockets were fashioned from $\frac{7}{16}$ in. lengths of $\frac{1}{4}$ in. diameter brass tube, and are soldered to the base-plates. These were filed up from 20-g. sheet brass, and are riveted to the buffer beams with $\frac{1}{16}$-in. rivets.

The Wheel (Axle) Frames

These were cut and filed up from 20-g. sheet iron, and as the axle boxes are dummies, actually serve as bearings. Each one was bolted separately to the longitudinals.

The Axle boxes

These were shaped up in one piece from 22-g brass and are soldered permanently to the frames.

The Springs

The laminations were made from $\frac{1}{8}$-in. × 1/32-in. strip brass and are soldered together into their prospective sockets, which in turn are soldered to the tops of the axleboxes, making each frame accordingly, one compact group.

after soldering each wheel separately to a short length of steel rod, inverting each into the hand-drill brace, clamped in the vice, and doing a spot of "turning" with the file and emery paper, a reasonable polish was obtained, and the residue around the spokes was simply boiled away with soda water.

The Axles

These are lengths of $\frac{3}{16}$ in. diameter mild-steel rod, the wheels being slid on at a light fit and sweated with solder.

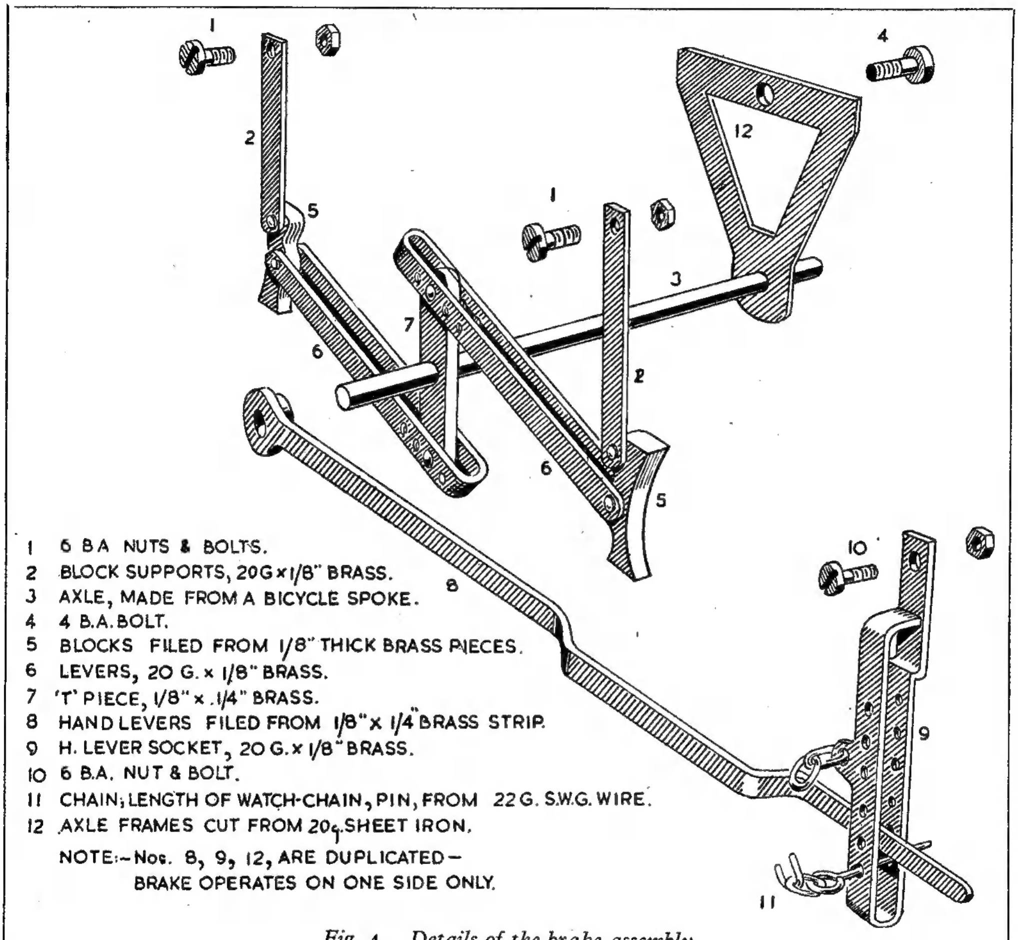


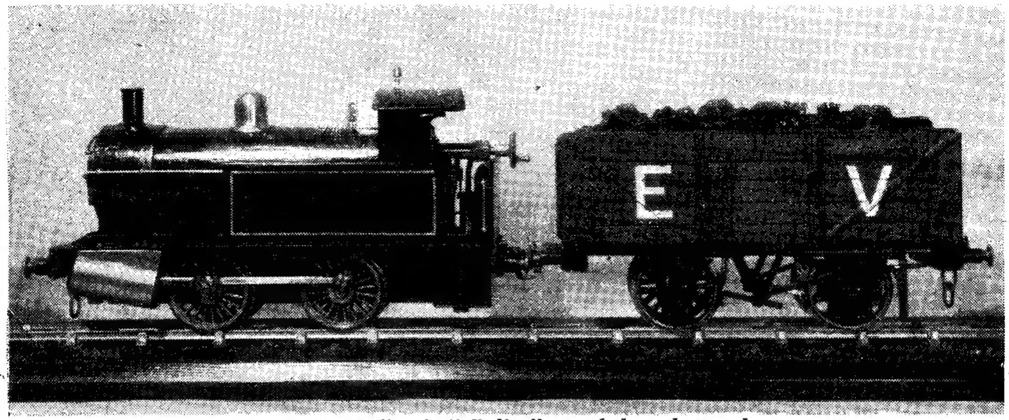
Fig. 4. Details of the brake assembly

The Wheels

These are brass, and judging from appearance, not only did they appear to have been "home-cast," but they were also of some considerable age. In fact, according to the proprietor of the shop at Richmond, where they were purchased, they were well over 50 years old, and originally belonged to the bogie of an engine long since lost trace of. At any rate, judging by the amount of tarnish and residue, this statement was well within the bounds of truth. However,

The Brakes. Figs. 1 and 4

Having discovered, during my "note taking" session that there appeared to be several ways of actuating the brakes, I was rather at a loss, at first, what to choose in this respect. However, after much "humming and ha-ing," not to mention a preliminary bout of head-scratching, I decided to concoct a mild replica of the more



Mr. J. E. Jane's "Juliet" coupled to the truck

general type, that is, with the brakes actuating on one side only. I pretty soon found that to make them look right was one thing, but to make them actually work was quite another. However, work they had to, and that was that.

With the exception of the blocks, which were filed up from pieces of ⅛ in. thick brass, and the shaft which was fashioned from a bicycle-spoke, all sections were made from ⅛-in. × 1/32-in. brass strip. As the distance between the wheels is shorter than normal, the fitting of the complete unit was rendered more difficult, as the screws had to be made just that much shorter; in the consequent altering of the amount of leverage from the hand lever, I had to be very careful in making an allowance accordingly, otherwise the lever, when "on" would have just about been trailing along on the rails.

CATALOGUES RECEIVED

Bonds O' Euston Road have sent us a copy of the 1950 edition of their "Model and Experimental Engineering Handbook." Readers who can remember the pre-war editions of this well-known and useful production will be glad to know that, in the 1950 edition, something very near to the old standard has been achieved. The first seventeen pages are devoted to hints, tips and other data of use to the model maker, covering such subjects as model railways, clockwork and electric locomotives, miniature steam locomotives, valve-gears, steam fittings, model yachts, tools and workshop equipment. There are also some tables of decimal equivalents, wire gauges, twist drill sizes, etc.

Then follow 111 pages of particulars, illustrations and prices of the great range of goods and products stocked at this famous establishment. There are many new items, most of which have recently been noticed in our pages; we note, however, a new Gauge "1" locomotive which should have a wide appeal to the many readers who seem to be reviving interest in this particular gauge. As designed, this locomotive is a simple 0-6-0 tank engine with outside cylinders and slip-eccentric valve-gear. At present, only the drawings, castings and materials can be supplied; but the design is perfectly straightforward and includes an interesting new type of boiler which is fitted with fire-tubes and water syphons. We understand that it is perfectly successful on spirit firing. The cylinders are of a new design, being cast in one piece with the blast-pipe, an idea which overcomes the need for the usual awkward piping.

The model car interest is catered for by the inclusion of some well-known 10 c.c. and 5 c.c. racing car kits and a useful range of parts for model race cars.

The rest of the catalogue covers a very comprehensive selection of products appealing to model engineers, whatever their interests may be; and anyone desirous of fitting up and equipping a home workshop will find much in it that will assist him in deciding what to purchase, for there are several new additions to the Tools section. In short, there is something of everything to be found in this very praiseworthy little volume, the price of which is 1s. 9d.

We received recently from **Messrs. Grey & Rushton (Precision Tools) Ltd.,** 93, Far Gosford Street, Coventry, a copy of their latest catalogue in which is listed their range of precision instruments, including 12-in. and 16-in. Vernier height gauges, Universal bevel protractors, Vernier depth gauges, knife edge Vernier calipers, sine bars, screw pitch gauges and vee-blocks. One of the screw pitch gauges has been submitted for our inspection, and it is an accurate and well-finished tool, at a very moderate price.

Having had considerable experience with Grey & Rushton equipment during the war years, we feel that we can, with confidence, recommend them to readers requiring a really first-class article. Prices and a copy of the catalogue may be obtained on application to the above address.

PETROL ENGINE TOPICS

A 10 c.c. Twin Four-Stroke

by Edgar T. Westbury

IN the course of discussions at model engineering society meetings and lectures, it often falls to my lot to hold the brief for the defence of the model petrol engine, which is put in the dock on indictments for many serious offences, all too familiar to need enumerating here. I flatter myself that I know most of the answers to the charges laid against the petrol engine by its avowed opponents, but sometimes I have the far more difficult task of saving it from the witnesses for the defence; or in other words, its own devotees, who unconsciously provide much evidence, or at least propaganda, for the prosecution, by their enthusiastic disregard of its most obvious vices. My recent suggestions that every effort should be made to reduce the noise of petrol engines, while well received in most model engineering circles, were very sharply criticised by many racing enthusiasts, who resented anything which might conceivably affect engine performance; and my reply that high efficiency was not the only thing that mattered in model petrol engines aroused a further howl of protest.

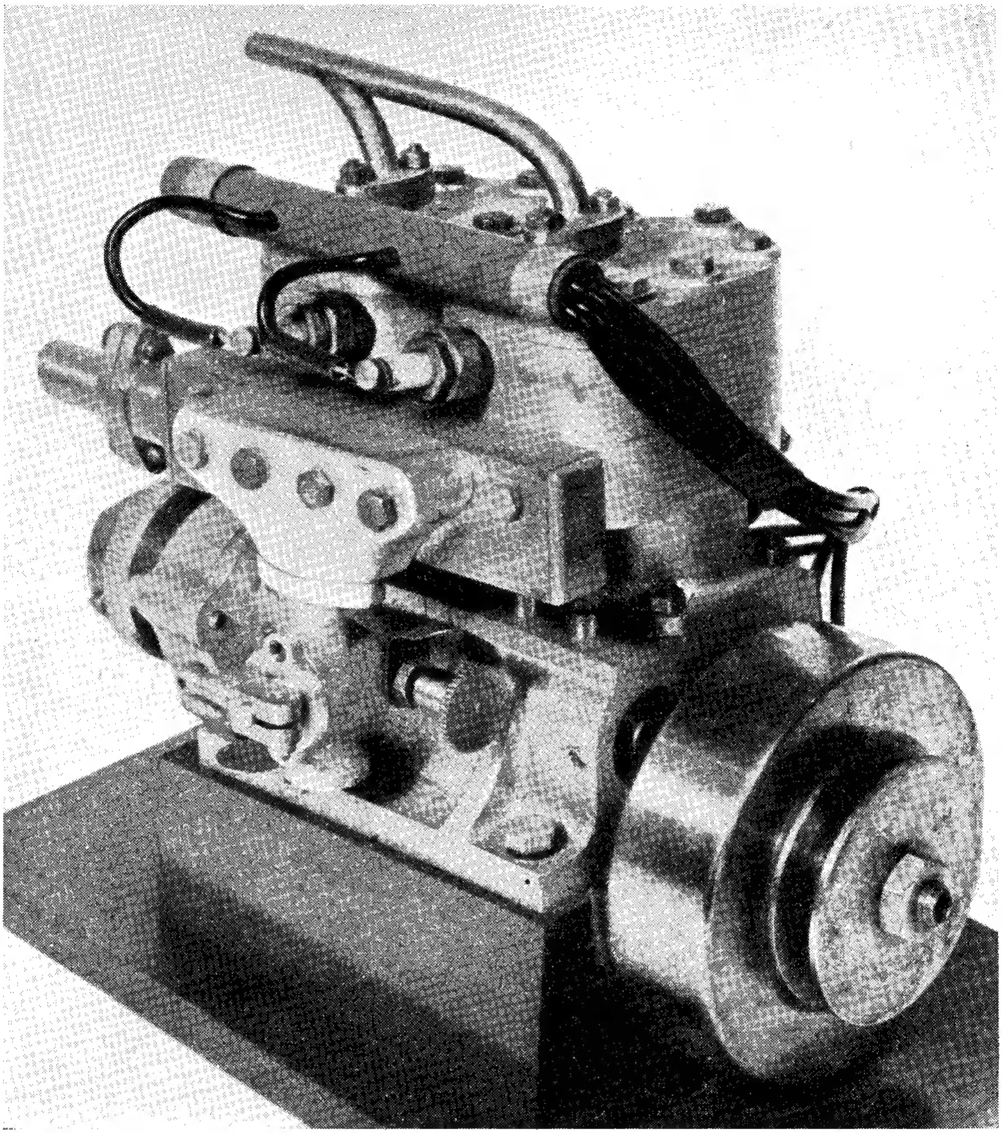
There are, however, signs that many keen model engineers are beginning to appreciate the possibilities of engines for purposes other than racing, if only to escape from the monotony of the present-day racing cult, where one-track ideas prevail, and engines seem to be rapidly approaching a stereotyped form of design. Consciously or otherwise, they realise that this cannot be the true path of progress, but the individualist and original designer has all the cards stacked against him under present conditions, which encourage nothing but sheer speed without regard to how it is attained. Competition is a good thing, and is essential to promote progress, but when an engine becomes nothing more than a means to a single end, interest in the finer points of its design is bound to decrease, and thus the main object of its very existence is defeated.

Some of the most promising model petrol engine constructors have already lost interest, and have either dropped out altogether or have turned to other, and mostly non-competitive, branches of model work. There are, however, many whose interest in petrol engine design is still strong, and who regard the actual construction of an engine at least as worth while as its ultimate performance. This, of course, has always been my own attitude towards these engines, all through the many years in which I have been writing "Petrol Engine Topics," though many of my readers, especially the "ultra-moderns," apparently fail to appreciate this point of view. To me, engines, or any other type of models, are objects of interest and indeed affection, and I regard them, as I do my friends, not merely for what I get out of them, but more for what they are. I ask you, readers, to judge whether this is not preferable to the regard which a boxing promoter has for a prospective champion—and which is the only sort of regard which some of our racing enthusiasts seem to understand.

Many of the designs for engines which I have published in the past have had no claim to super-efficiency, and indeed I have always realised that whatever possibilities in this respect may be offered by the design, its interpretation by the constructor is the critical factor which may make or mar its success. I make so bold as to claim that many of the most successful exponents of the model petrol engine have been introduced and initiated into its mysteries by such simple and modest designs as the "Kiwi," "Kestrel," "Atom Minor," and "Kinglet" engines, which have taught them more about design and construction than would have been possible if they had attempted to launch out immediately into the high efficiency field. Not that any of these engines are inefficient, even by the most modern standards—they are elementary, but sound exercises in design, in which the object has been, first to assist the constructor to *build* an engine—and think about winning competitions with it afterwards.

In the case of engine designs which have been described as suitable for racing, a good many beginners and others have obtained success with them, either built exactly according to the drawings, or modified in detail. These include the "Kittiwake," the "Atom V," and "Ensign" engines. Just recently I saw a very promising first run with a speed-boat fitted with an "Apex Minor" 15 c.c. four-stroke engine—a pre-war design, which has hitherto been passed by or overlooked by most of the racing fraternity. I mention these facts, not with the intention of usurping credit for successes which are justly due to the patience and efforts of the individual constructors, but as evidence that the designs have at least provided a solid basis for such success.

Since the introduction of the "Seal" 15 c.c. four-cylinder engine, many readers have been attracted to this line of design, and apart from many who have actually built this engine, others have been encouraged by its success to go still further, and produce more ambitious forms of multi-cylinder engines. To many sceptics who openly doubted that such an engine could ever be successful, the flexibility and quiet running of the "Seal," has been a revelation, and some of those who saw Mr. Cummins' example of this engine running at last year's "M.E." Exhibition,

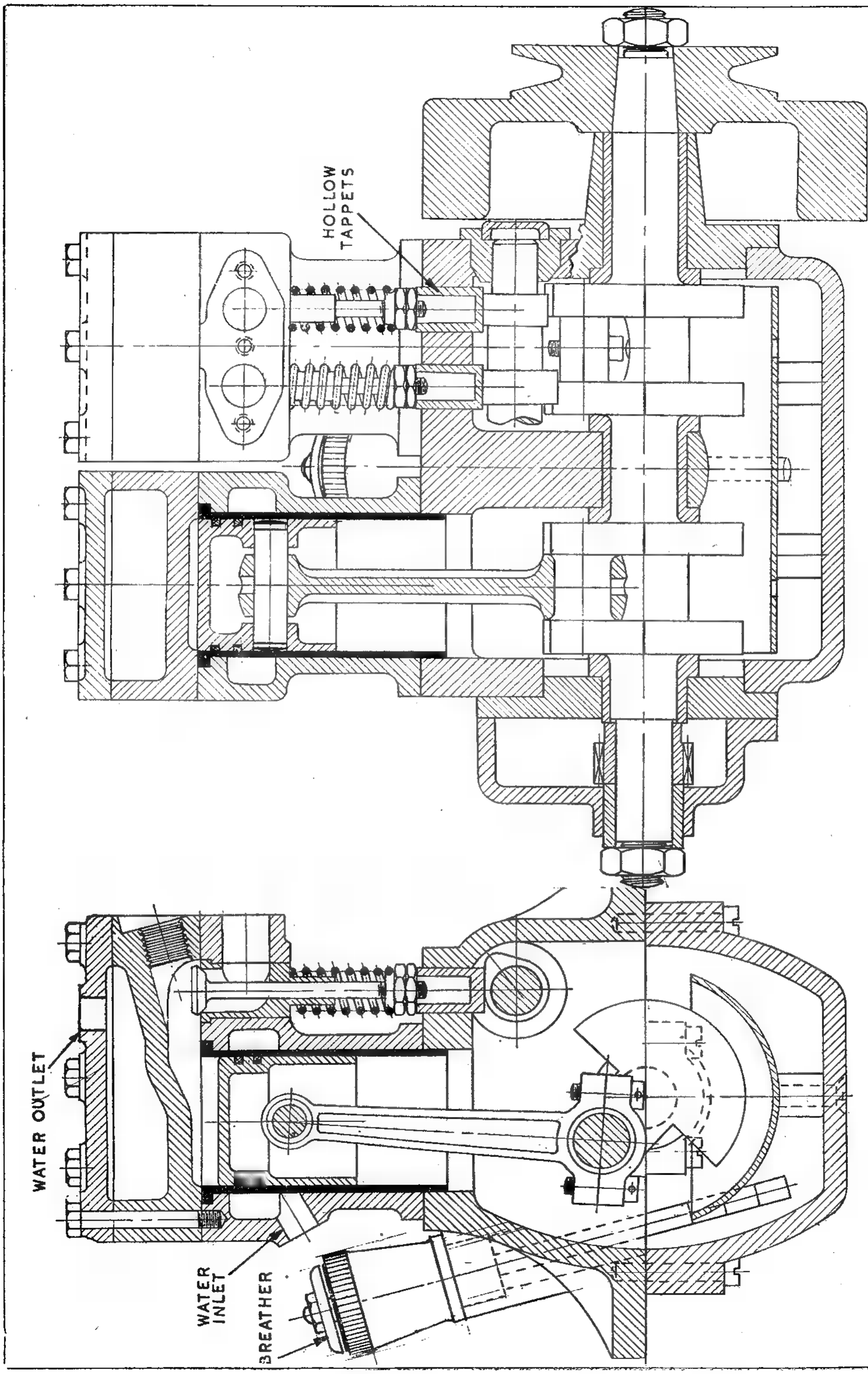


The " Seagull " 10 c.c. twin engine in the initial stage of development ; the exhaust manifold and certain other minor details have since been modified

or the later example built by Messrs. Bontor and Marshall, have confessed that they had never before realised how fascinating a small petrol engine could be.

Unfortunately, not all the constructors of this engine have been able to carry it through successfully ; despite my warning that this could not be regarded as a beginner's engine, it has been tackled by many novices, who did not realise the amount of work involved, or appreciate how important even the simplest components in it could be. In other cases, older and more cautious model engineers have expressed their liking for the engine, but have doubted their ability to construct it, though I firmly believe that the recognition of their own limitations would have been an important asset to success.

However, I certainly agree that there is a strong case for introducing a design which is an intermediate stage between the " one-lunger " and the " multi," incorporating some of the rugged simplicity of the former in combination with the flexibility and smooth running of the



General arrangement of the "Seagull" 10 c.c. twin engine (full size)

latter. This policy has been put into practice in the design which is presented here—a design, I may add, which has been "cooking" for [redacted] long time, far too long for some of the enthusiasts who had [redacted] preview of the external appearance of the engine, possibly [redacted] little prematurely, at last year's "M.E." Exhibition.

It will be seen that this engine, which has been given the name of the "Seagull," is a vertical twin side-valve engine, a particularly interesting type in view of present-day developments in certain branches of full-size practice. The cylinders are separate, with individual cylinder heads, and the pistons operate on [redacted] two-throw crankshaft, with the two crankpins in the same plane, so that they move in unison. This form of engine is known as [redacted] "360-degree twin," and it is not the first example of such [redacted] design which I have published in THE MODEL ENGINEER, as the 30 c.c. engine of the "1831" locomotive was of this type, though it had overhead valves and "monobloc" cylinder and crankcase construction, with [redacted] single casting for the two cylinder heads. Incidentally, it may be mentioned that this engine was highly successful, and has been adopted for other purposes besides that for which it was designed, including marine work; castings and detailed drawings of it are still available for those who may be interested in a powerful twin engine of this capacity. I recently saw [redacted] finely-built large model of a cargo liner, having an "1831" engine installed, at a provincial regatta, and the performance of the engine in this capacity, including starting and speed control, appeared to be highly satisfactory.

The "Seagull" engine of 10 c.c. is intended mainly to suit the smaller sizes of "prototype" (i.e. non-racing) boats up to 3 or 4 ft. in length, and will provide sufficient power for propelling them at convenient cruising speed. Like the "Seal" engine, it is of the side-valve type, which is slightly less efficient than the best examples of overhead-valve engines, but is, generally speaking, inherently more flexible and quiet-running, and maintains its adjustments longer; moreover, the smaller number of working parts makes it somewhat easier to built. The general design of the engine is intended to give [redacted] characteristic representation of the type of engine which has for many years been popular for propelling small river and harbour boats, and has been manufactured by several makers, with little variation of design. Among the salient features which I have thought it desirable to reproduce in the model are the copper water service pipes and the fibre conduit for the ignition wiring, which were almost universal fittings in these engines; but many of the less obtrusive features have been modified or simplified, to adapt the design to the methods of construction available to the model engineer.

Most readers are aware that the vertical, or at any rate, side-by-side twin four-stroke engine has in recent years become extremely popular in motor-cycle practice, though it can scarcely be regarded [redacted] new development, as engines of this type were employed in some of the earliest motor-cycles. Though it was long neglected in favour of vee-twin and flat-twin arrangements, it has now staged quite an effective come-back, quite rightly in view of its practical merits. The "360-degree twin," *properly designed*, has [redacted] very even torque, which promotes flexibility and reduces wear and tear, while its mechanical layout is generally more compact and robust than other types of twins; [redacted] further advantage is that it enables a better induction and distribution system to be used. While the balance is theoretically very imperfect, as there can be no opposition of reciprocating forces, it enables the magnitude of these forces to be kept smaller than in a single-cylinder engine of similar capacity, as the moving parts are much lighter; and the "couple" inherent in the 180-degree twin is eliminated completely.

Most modern motor-cycle engines of this type have an internal flywheel in the centre of the crankshaft, incorporating the balance weight, and this is quite [redacted] good location for it; but in the "Seagull" engine, an external flywheel is used, as more in keeping with the general character of marine engine design, and the crankshaft has [redacted] centre bearing which helps to promote steady running, and improves the durability of the shaft and bearings. Quite [redacted] number of the working parts, including the timing gears, valves, etc. are identical with those of the "Seal" engine, while others vary only slightly in dimensions, or are designed to be made by methods which have proved successful in this engine. During the course of development, certain details of the design have undergone minor modification, and the photographs of the engine in its original form therefore differ in some respects from the drawings, which represent its final stage of development.

One point in which the engine differs from the "Seal" engine is that the ignition gear has been simplified, and no high-tension distributor, is used; in place of this, a single coil of the double-pole type is employed, firing the two plugs in series, once per revolution, so that alternate sparks in each cylinder are wasted. The possibilities of this and other simplified ignition systems were referred to in dealing with the "1831" engine, though it was not adopted in that case; with a four-cylinder engine, it is not practicable to use [redacted] *single* ignition coil in this way, but two double-pole coils could be used in conjunction with a double contact-breaker.

While the majority of readers likely to be interested in this engine will probably be quite satisfied with its designed form, as a twin, it may be remarked that it is capable of "expansible development" and may, in fact, be built with any number of cylinders from one to six, or even more, simply by suitable modification of the crankcase, crankshaft and camshaft design. Whether there is likely to be any demand for drawings of the modified arrangements I do not know, and I do not propose to give drawings of alternative details unless they are in fairly wide demand; but already several of my friends have suggested that the single-cylinder version would be [redacted] popular alternative to the twin, for the benefit of those constructors who appreciate the true marine flavour of the design, but do not wish to go to the trouble of duplicating cylinders and other working parts.

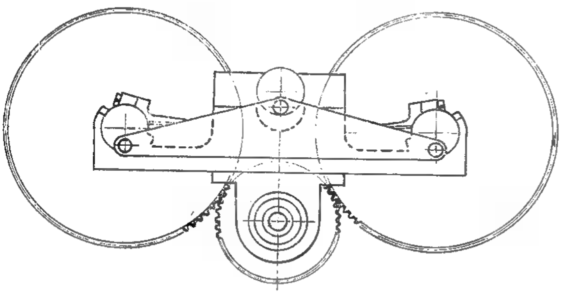
(To be continued)

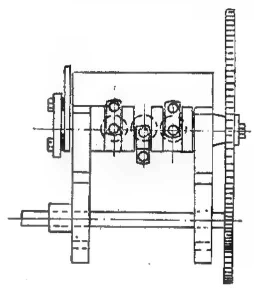
A Three-Cylinder Contra-Piston Uniflow-Type Steam Engine

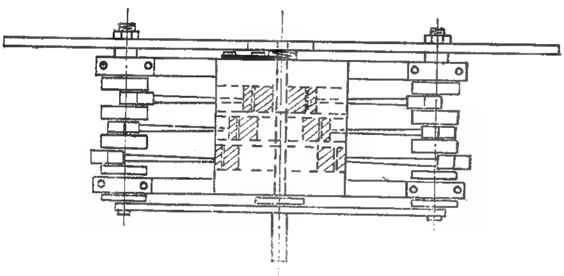
THIS engine was originally designed, for use in a twin-screw steam launch. It works on the uniflow principle, and has three cylinders, with two contra-pistons in each.

A single inlet port in the centre of each cylinder is fed from a rotary valve, operated by a connecting-rod and cranks, seen in the foreground of the photograph. The large gears, seen in the background are in mesh with an idler gear, pinned to a shaft running in ball-races, the driving end of which can be seen in the foreground.

The cylinder block is machined out of brass, and has three bores, 17/64 in. diameter, which were reamed and lapped. The inlet ports are drilled in the centre of each cylinder and three



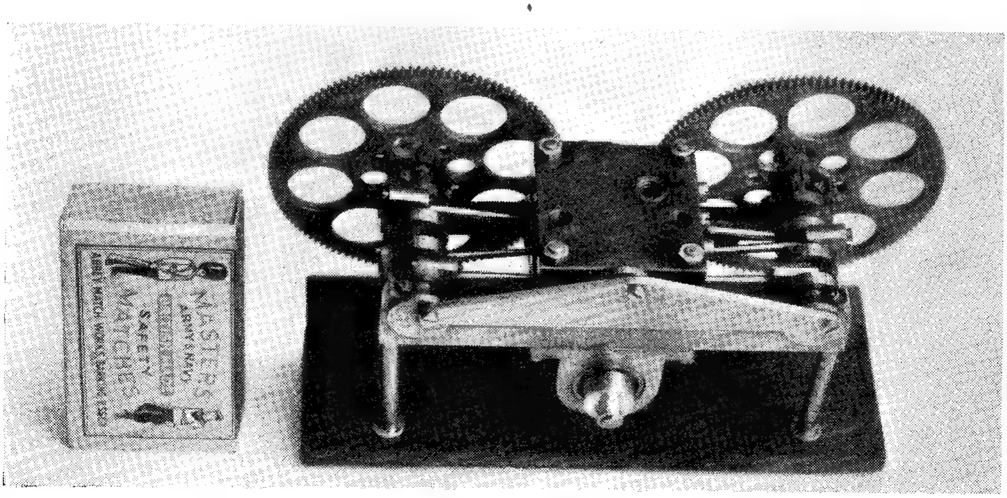


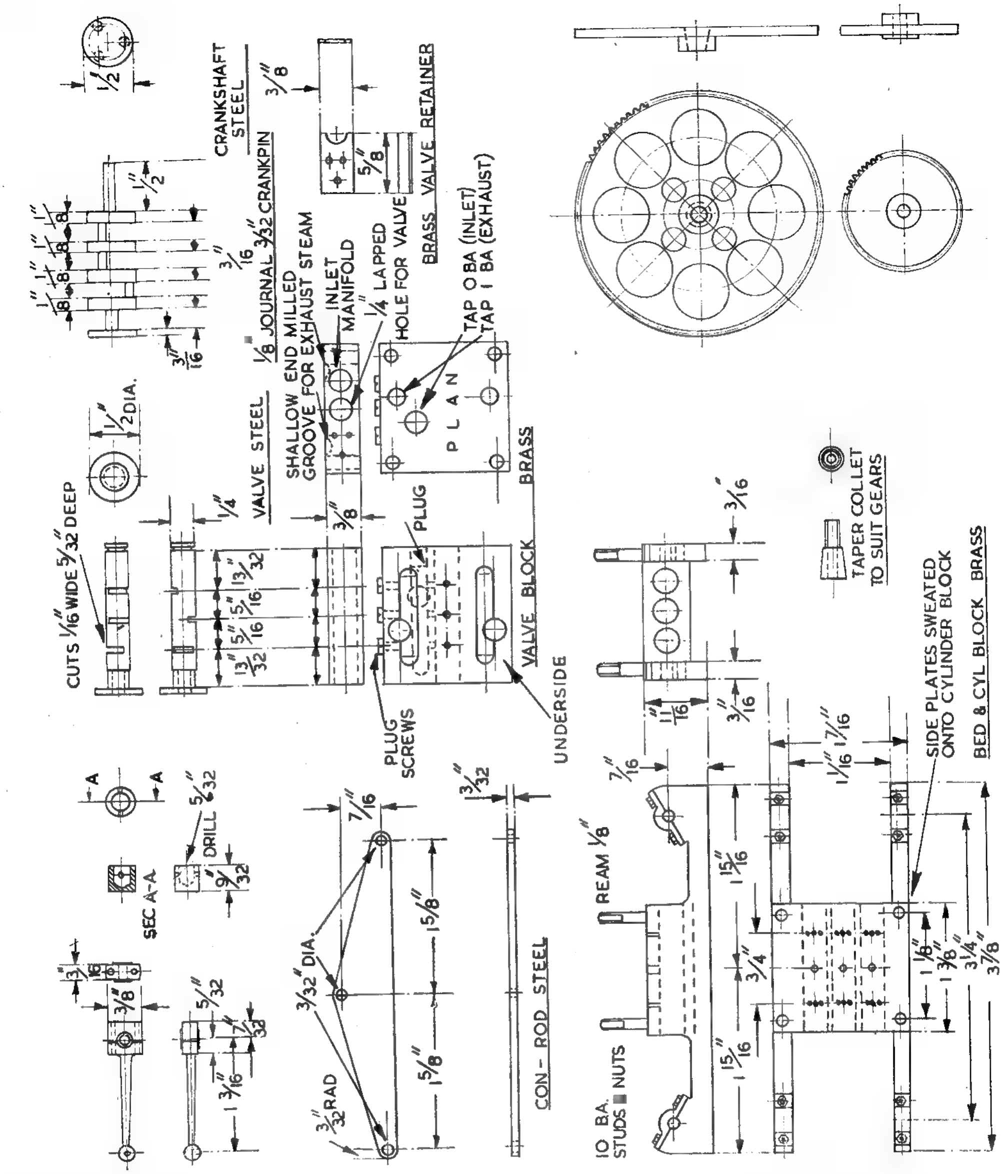


holes, 3/64 in. diameter, drilled at the end of the piston stroke on each cylinder, serve as exhaust ports.

The pistons are made of steel with 3/64 in. diameter gudgeon-pins. The connecting-rods are brass, with split big-end bearings and the crankshafts are made from high tensile steel, machined from solid with 3/32 in. diameter crankpins and $\frac{1}{8}$ in. journals.

The large gears are of steel, the central bores being tapered, into which split draw-in collets fit. These collets, which are threaded to take





a small nut, draw in on the taper and close concentrically on the crankshaft. The large gears also act as flywheels.

The rotary-valve, is made of ¼ in. diameter silver-steel lapped to a dead smooth parallel finish, and has an adjustable crank at one end. This valve has three saw cuts in line with the inlet ports.

A bit of juggling was necessary in order to time the steam inlet into each cylinder correctly. The valve relies on its close fit in the valve-block to stop any leakage of steam.

After many disappointing tests, in which the engine seized up after very short runs using various grades of oil as lubricants, it was found that a drop of colloidal graphite made it run perfectly, and steady running is now practicable at all speeds.

I have not detailed the drive shaft assembly or the gears, as these will, I expect, depend on the scrap-box, as in my case.

The valve timing of the engine must be done by trial and error.

A point that might help is : before pinning the flange on to the valve, fit ■ set-screw about 10 B.A. and then the flange can be adjusted at will. I can, of course, see lots of improvement in the way of lightening the engine if it is to be fitted to a boat, but that, too, is best left to readers.

—D. H. DRAY.

Novices' Corner

Making Washers

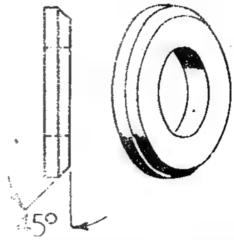


Fig. 1. Standard form of washer

AS washers of the commercial pattern in all standard sizes can usually be bought from the tool merchant, there may seem to be but little point in going to the trouble of making these articles in the workshop. It may, however, be found that in instrument work, for example, the finish of commercial washers is out of keeping with the rest of the parts, and, again the appearance of a well-made model may be marred by the presence of roughly finished washers fitted to the bolts and nuts. Furthermore, the dimensions of standard washers may render them unsuitable for use in scale models or with bolts and nuts of special size.

Commercial washers of the kind illustrated in Fig. 1 are usually stamped out of steel plate, and the central hole may in this way be made considerably larger than the nominal clearing size; for example, the holes in a number of ⅜-in. washers of different makes were found on measurement to be some 15-thousandths of an inch over-size. The unmachined front and back surfaces of the washers correspond with those of the sheet metal from which the parts are stamped. The chamfered edge of the washer is usually machined to a rather rough finish, and the outer edge is likewise machined or it may be left untouched after the stamping operation.

If a washer is to be a close clearing-fit on its bolt and is to be well finished all over, it will, almost certainly, have to be made in the workshop. Fortunately, washers can easily be made from round bar, and at the same time machined on all surfaces, and it will generally be found that this is both quicker and more satisfactory than trying to improve the finish of a batch of standard washers.

Machining Washers

At the outset, it is advisable to make a sketch showing the dimensions of the washer required. The central bore should be a close, but free sliding-fit on the bolt, and the outer diameter should exceed the nut diameter, taken across the corners, by a little more than the width of the chamfer itself. It is a good plan to take a washer that goes well with the nut fitted, and to use this as a guide for the machining.

The series of operations employed for machining a batch of washers is illustrated in the drawings in Fig. 2.

When making steel washers it is best to select a length of free-cutting mild-steel rod, as this material is easy to machine and takes a high finish from a sharp turning tool. The rod is gripped in the self-centring chuck with sufficient overhang to allow several washers to be made without having to loosen the chuck jaws and draw out more material; but where the diameter of the rod is small, the overhang must not be excessive, or difficulty may be experienced later when parting-off.

The rod is bored by using a centre drill, a pilot drill, and the clearing size drill mounted successively in the tailstock drill chuck. The depth to which the hole is taken should exceed the total thickness of all the washers, plus the width of metal removed by the tool for all the parting-off operations.

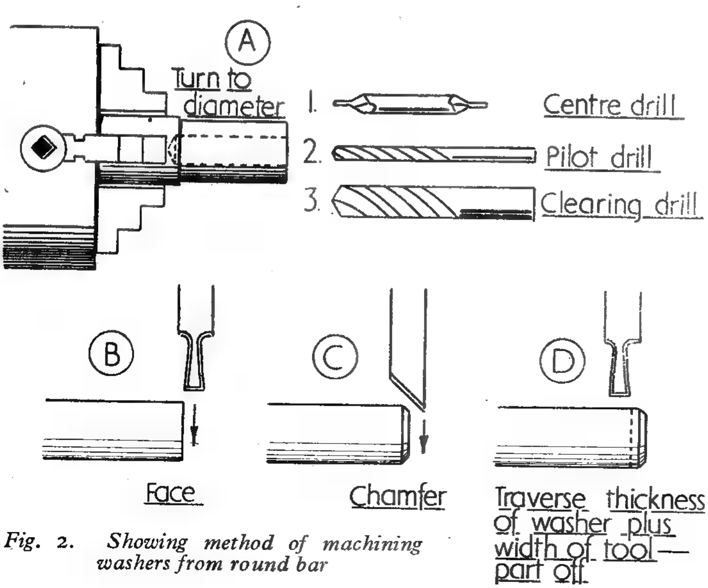


Fig. 2. Showing method of machining washers from round bar

The rod is now turned to the finished diameter of the washers, either with a knife tool mounted in the ordinary toolpost, or by using a tool held in the back toolpost.

For the subsequent operations, the illustration shows the back toolpost in use, but the work can, of course, be carried out quite well from the front toolpost attached to the lathe top-slide.

The back toolpost has been chosen in this instance, as the two tools carried in the revolving turret-head will do all the necessary machining, and, moreover, parting-off is made much easier even with the lathe running at high speed. The end of the rod is now faced with the parting-tool to remove any burrs resulting from the drilling operation, and the reading of the leadscrew index is noted for future reference. The chamfering tool is next turned into position, and the chamfer is machined to the required width. The breadth of the chamfer can usually be estimated quite well by eye, but if absolute uniformity is preferred, the reading of both the leadscrew and the cross-slide index should be noted and repeated at each subsequent chamfering operation. To part-off the washer to the specified thickness: turn the parting-tool into position and rotate the leadscrew to bring its index to the reading already noted for the facing operation; measure the width of the parting-tool with the micrometer and use the leadscrew index to traverse the tool by this amount; measure the thickness of a selected pattern washer and again traverse the tool for this distance.

This may all sound a little confusing, but to take a simple example: the rod was faced with the leadscrew index in the zero position; the width of the parting-tool was 80-thousandths of an inch, and that of the washer, 40-thousandths, making a total of 120-thousandths; if a 5-thousandths cut is taken when facing the remaining washers, this brings the total traverse to 125 thousandths and the leadscrew index is back again at the zero position for each parting-off operation.

Parting-off methods have previously been described in detail and no further comment is needed, except to point out that a parting-tool with an obliquely ground edge may here be used with advantage, for this will leave the back of the washer cleanly machined, and the cuff of metal left on the end of the rod will be removed by the subsequent facing operation.

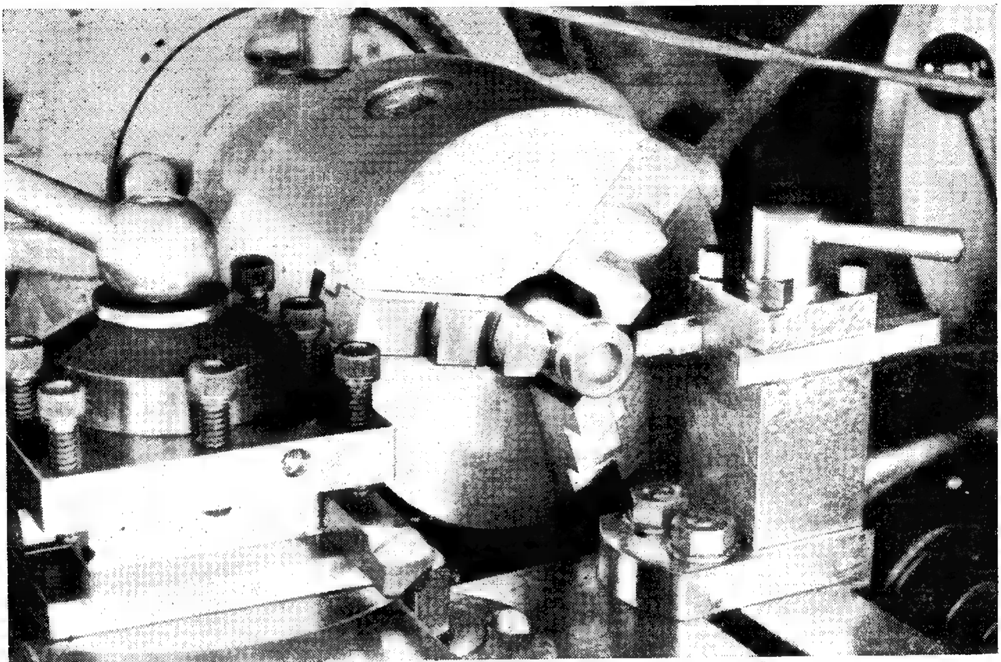


Fig. 3. Using the back toolpost for parting-off washers

Any number of washers can be machined in the way described, for, when the prepared end of the rod becomes used up, the material is drawn through the chuck and the series of operations is repeated. When making large washers having a bore greater than the drilling capacity of the tailstock chuck, the bore drilled in the material is enlarged to the required size with an ordinary boring-tool.

Where a commercial washer is used with a bolt having a smaller than standard hexagon head, either the diameter of the washer will be too large to give a good appearance, or if a smaller washer is selected its bore will be too small to fit the bolt.

For example, if a standard $\frac{3}{8}$ in. Whitworth washer is fitted to a $\frac{3}{8}$ in. diameter B.S.F. bolt, the washer will look much too large, as here a standard $\frac{5}{16}$ in. Whitworth washer has the correct outside diameter. Should a $\frac{3}{8}$ in. B.S.F. washer

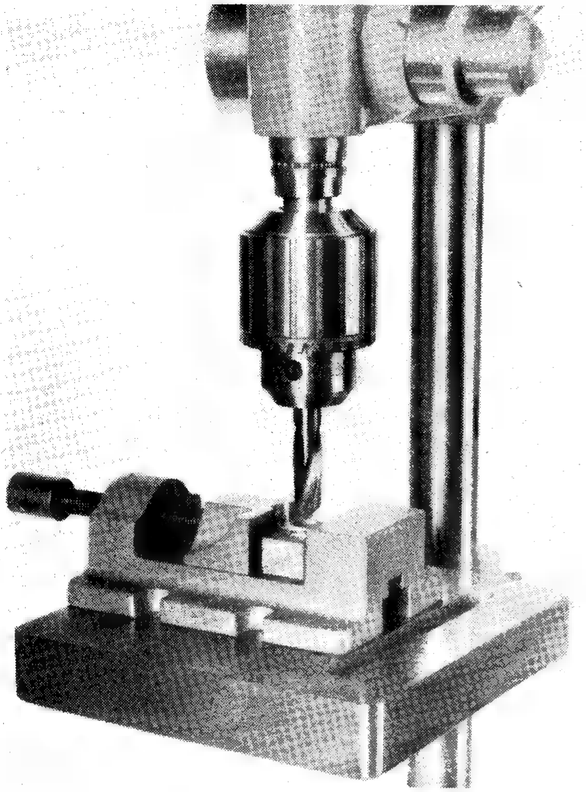


Fig. 4. Enlarging the bore of a washer in the drilling machine

not be available, this difficulty can be overcome by enlarging the bore of the $\frac{5}{16}$ in. washer to $\frac{3}{8}$ in. This can be done quite easily in the drilling machine in the manner illustrated in Fig. 4.

The washer is supported to lie level on a strip of wood placed in the machine vice, and the vice-jaws are closed to grip the edge of the washer, and so keep it from turning while the $\frac{3}{8}$ in. diameter drill is put through. To remove the burrs on the under side formed by the drill, the washer is turned over in the vice and again gripped to allow a light cut to be taken with a countersink mounted in the drill chuck.

When opening out a hole in this way in thin material, the drilling machine should be run at slow speed to prevent chatter, and a light feed should be used to keep the drill from grabbing as it emerges.

Where the edge of a damaged washer needs smoothing, or for that matter to finish the edge of a commercial washer, this operation can also be carried out quite effectively in the drilling machine.

For this purpose, as shown in Fig. 5, a taper pin or small tapered arbor is lightly driven squarely into the washer. The washer is supported on a punching block with its chamfered edge downwards, and the arbor is then carefully tapped into place. It will be found easier to keep the arbor truly vertical if it is gripped in the drilling machine chuck and then pressed lightly into place with the machine's feed gear. The arbor is now reversed in the chuck so that the chamfered surface of the washer lies uppermost, and, with the drilling machine running at high speed, a fine file is applied to both the chamfer and the outer edge of the washer.

This method of mounting a washer in the drilling machine is illustrated in Fig. 6, and satisfactory results can be obtained if care is taken to secure the washer, so that it runs without wobble.

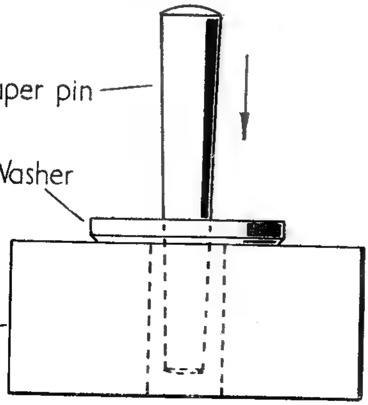


Fig. 5. Screwing the washer to a tapered arbor

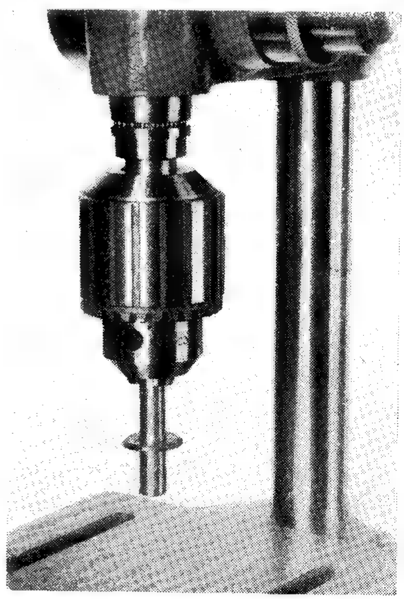
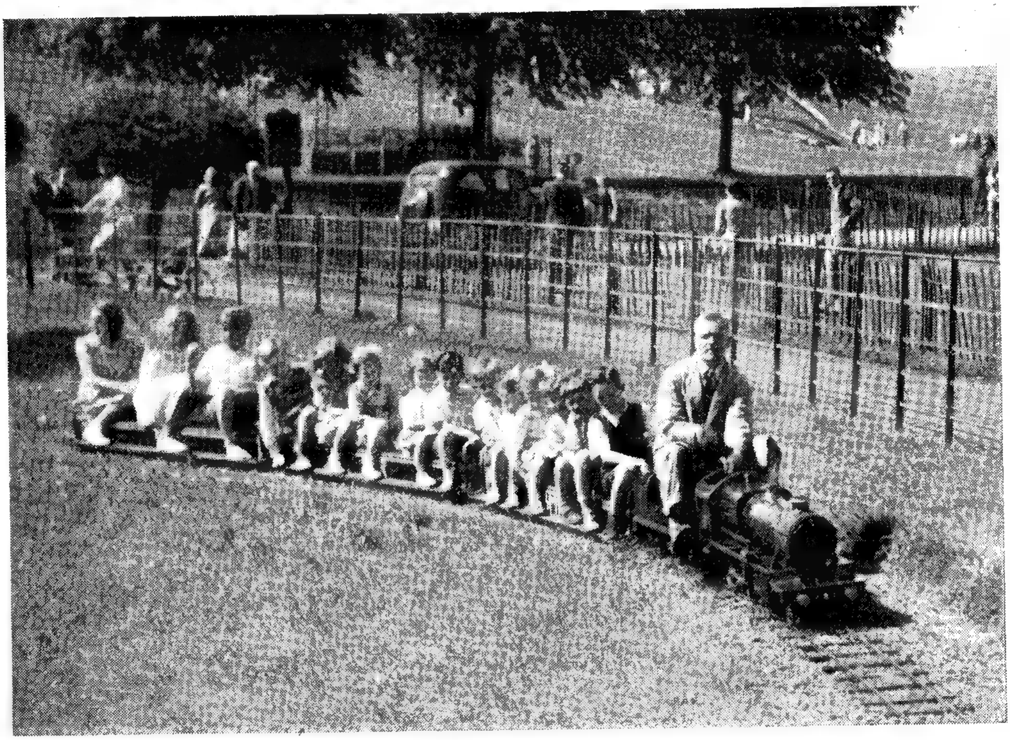


Fig. 6. Method of mounting a washer for finishing its edges

A Public Park Miniature Railway

by David Scott

THE engine is a joint effort of myself and my friend Mr. G. Hamilton, and is, with the exception of a few minor details, the same as Mr. Schwabs' as described by him in THE MODEL ENGINEER, in 1944.



After receiving drawings from Greenly's, work was started in June, 1947, my equipment being a $3\frac{1}{2}$-in. Drummond-type Myford lathe, a $\frac{1}{2}$-in. Toco electric drill and a 6-in. electric grinder. I also had the use of an acetylene welding outfit, on which all brazing was done. The castings for wheels and cylinders, the latter in gunmetal, were cast at the local foundry from my own patterns, and they turned out very well. The pistons I cast myself from melted-down car pistons. Towards the end of October, I had the frames assembled and axleboxes fitted, ready for wheels and axles. All was now ready for the next step, to me the most interesting, the cylinders, motion and pump.

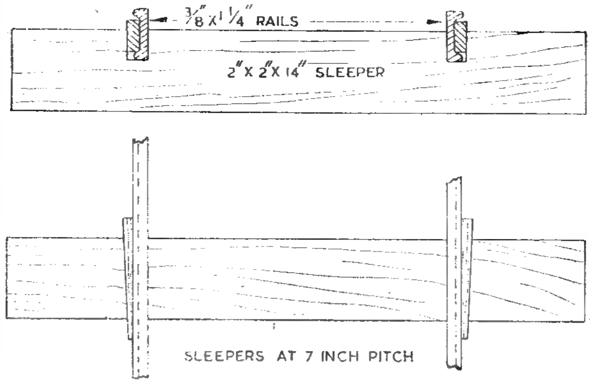
The pump is eccentric-driven from the second driving axle, and was tackled first; it proved to be a straightforward enough job, the eccentric having, of course, been fitted to the axle before the wheels were pressed on.

Towards the end of the year, I had the cylinders well under way, the most monotonous part being the boring and tapping of over 100 holes for covers, steamchest, cleading, etc. As all the holes were bored and tapped with the cylinder bolted to machine table to ensure trueness, this took some time; but it proved to have been well worth while when the time came for fitting the steamchest and cylinder covers.

After the valves had been carefully scraped to port face, guide bars and crossheads were made and fitted, after which the two cylinder assemblies were ready for fitting to the chassis. Meantime, my friend Mr. G. Hamilton had the boiler and tender under way.

After the cylinders had been fitted, connecting-rods, coupling-rods and valve-gear were started. This proved to be, while interesting, the most laborious part of the whole job. Phosphor-bronze bearings were fitted to connecting- and coupling-rods, and all pins in the

valve-gear were hardened silver-steel, fitted to reamed and hardened holes. As all rods are properly fluted, scraped and burnished, there were times when I didn't seem to make any progress at all. However, the day eventually arrived (in spring of 1948) when I was ready for a compressed-air test, and the performance of the engine and the appearance of the valve-gear justified my time and care.



Details of the track.

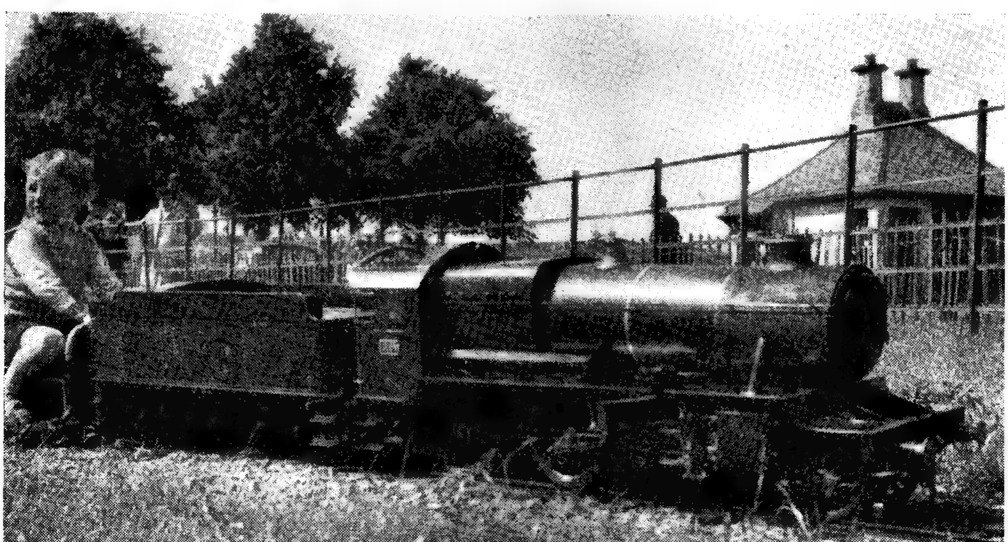
Cab and running-boards were now started; these are made from blue planished steel, riveted and unpainted. We have seen so many fine models spoiled by the paintwork, that we decided that the only paintwork on our model should be applied to the frames and buffer-beams, with a touch of red to show up the connecting-rods, coupling-rods and valve-gear fluting!

After the pony truck, buffers, brakes, etc. were made and fitted, the chassis was complete (15 months' spare time work) and was turned over to Mr. Hamilton who, by this time, had the tender finished and the boiler ready for fitting.

About this time we were asked by the local council to run a miniature passenger service the following summer in one of the public parks; so we made a start on the passenger trucks, and with a view to complete safety, I made them as low as possible. The body is mounted on two four-wheel bogies, the wheels with a long bearing running on a fixed axle; this gives a differential effect which, in my opinion, helps considerably on curves. For safety's sake, also, all truck wheels are double-flanged. Three trucks were made, and, we find, about seven or eight children can ride on each.

Material for the track was rather a problem, but eventually we were able to get 850 ft. of agricultural section, $\frac{3}{8}$ in. $\times$ $1\frac{1}{4}$ in. This is mounted on, or in 2 in. $\times$ 2 in. $\times$ 14 in. sleepers, the rails lying in machined grooves in the sleepers and secured by hardwood wedges (as per sketch). So far as I know, this method of building up a track is new, so we were anxious at first to see how it would stand up to the work. When building up a curve, the wedges on one side are slackened off, the section drawn round to the desired curve, and the wedges driven

(*Continued on page* 64)



*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

If you now have your engine in bits and pieces, uniformly spread all over the workshop, you will doubtless be in a highly nervous condition—it's so conducive to losing things, isn't it?

I regret to say that the job will remain in this condition until the cylinder units have been made and tried in place. In order to avoid getting into too much mess, box up all the small parts in tins, not forgetting to add a label to the lid, stating the exact nature of the part, and better still, numbering or marking the bits by some definite system so that you will know, when the time comes, exactly where and which way round the component goes back on the frames. It is very easy to go gaily marking everything with numbers, only to forget the order of the numbering at some later date; therefore, write it down in your notebook, or some place where the record will not be destroyed. The worst offenders are the small nuts and bolts, especially those that have odd-sized heads and nuts, such as the 6-B.A. studs with the 8-B.A. heads, mentioned some time ago; these might get mixed up with the genuine 8-B.A. nuts, and cause confusion.

The first job now is to deal with the extra drillings required in the frames and other parts. One sketch shows the forward end of the frames, with the cylinder fixing holes positioned, plus another large hole in the middle of the group, which I will explain later. Matching the fixing holes is a $\frac{1}{16}$-in. steel or brass plate, drilled in the same way, which I suggest should be made first, for use as a jig for drilling the frames. This plate will serve as a sandwich between the frames and the cylinder block, so make it carefully, exactly to size, quite square and flat. When it has done service as a frame-drilling jig, it should be marked or numbered so that you know not only which plate belongs to which side, but also which *face* of the plate, faces the frames.

When the cylinders have been machined, you will use the plates as jigs to drill the cylinder-block backs, after which you will be told how to cut the plates away until they are little more than holes tied together with plate—their object and purpose? Not only jig plates, as described, but spacers to prevent too much of the cylinder back surface coming into close contact with the frames, causing a quite considerable loss of heat by conducting it away to waste. You cannot use a "squashable" type of material for this job, such as asbestos sheeting, as this might compress unevenly, or allow the cylinders to rock or work loose on the bolts. Short, tubular spacers would do the job equally as well, but they would be a bit fiddlesome when erecting the cylinders; apart from this, you would lose the "jig" property of the plate.

The second sketch shows how the return spring for the brake cylinder should be made and fitted. Some questions likely to be asked here are: "How long should the spring be made?" or, "How many turns of what gauge wire?" or again, perhaps, "When you state spring length, do you mean *free* length or *compressed* length?" All these questions have actually occurred in the very recent past, but I am going to answer them by telling you to select a spring of any convenient length, and strong enough to return the brake cylinder plunger with reasonable certainty; if it will do this job with cold steam cylinder oil in the bore, it will most obviously do so when the cylinder is warm. A final word of warning—do not skip putting a through pin in the crank boss, and substitute a wretched grub-screw taken out of your old wireless set, relying on the grip of the screw on the shaft. This is just a lazy, makeshift way of avoiding the proper fixing.

Eureka—Or at Least I Think So

Having the brake question in mind, I might as well tell that I have a solution to the return spring problem for the rest of the gear. You may remember that I said I would go to earth and meditate on this point; but I *didn't*—it just came to me all of a sudden. I happened to have the engine upside down, and there were spring attachment points, staring me in the face

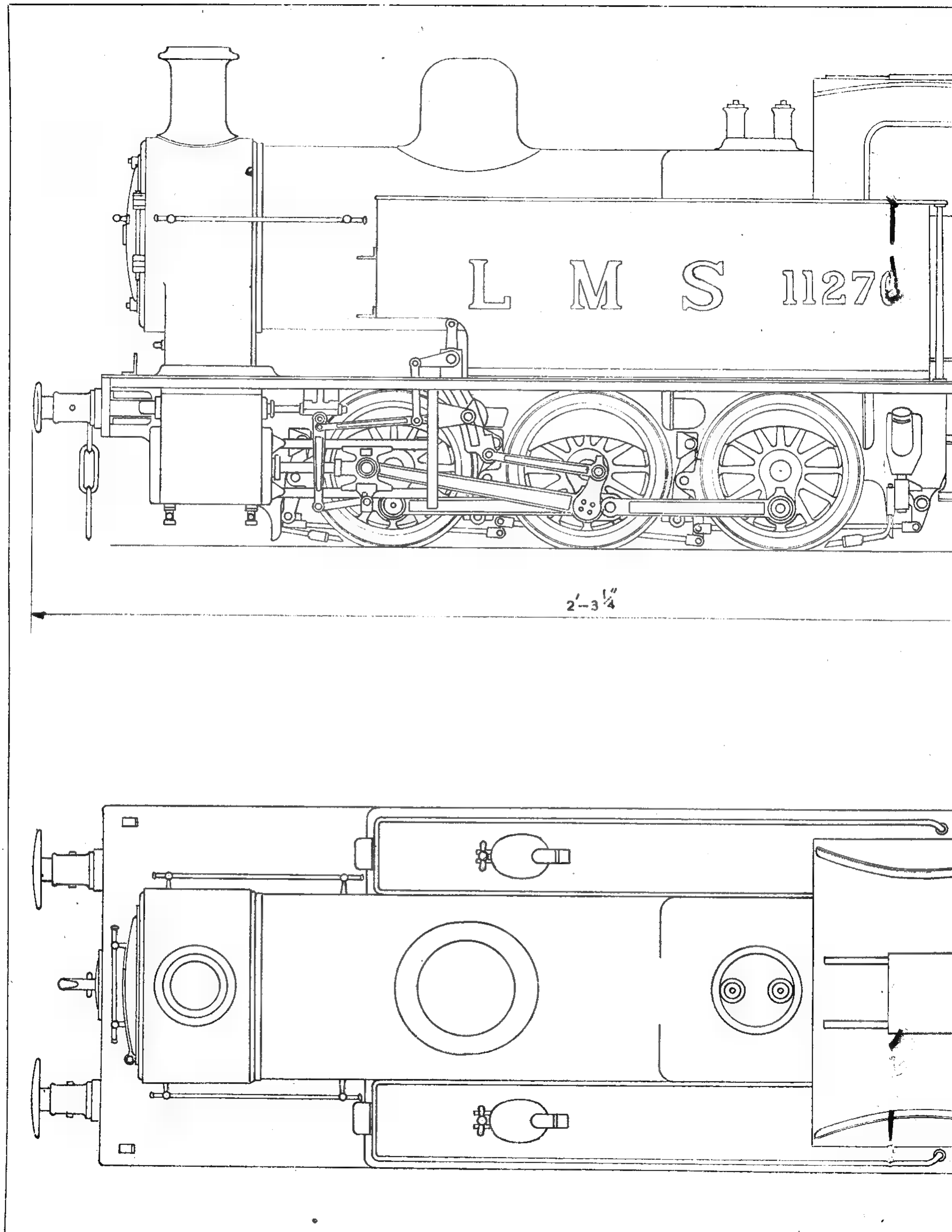
All that is necessary is to drill small holes in the three brake stretchers, as shown on the third sketch, and just for fun, let you guess the attachment points yourself—you will not need the correct answer just yet, in any case.

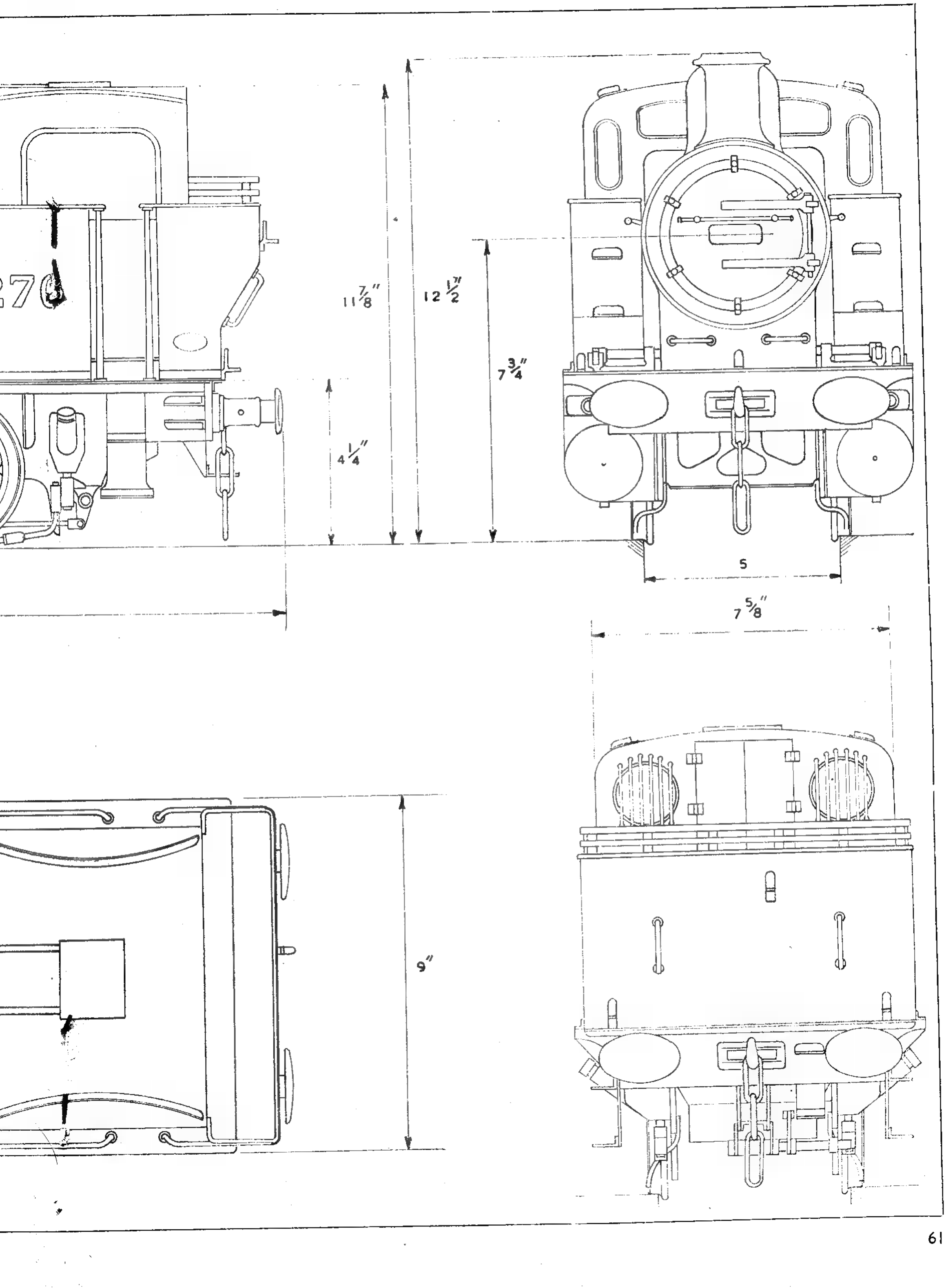
Dear Mr. Editor—Sir

I do not quite know how space will work out in this issue, but a sort of *magnum opus* has left my flowing (and unsteady) pen. It is the general arrangement of the engine being described and seen in four different views. They do not include quite a lot of the detail that will eventually adorn it. If I had put in *everything*, there would have been such a maze of lines that you might as well have had a direct reproduction of the prototype works drawings, and nobody would have been able to make head or tail of it.

I may or may not be in order here, but I *think* that from now onwards, blueprints of the various drawings will be available from THE MODEL ENGINEER offices direct, so look out for a statement to that effect and, when it is

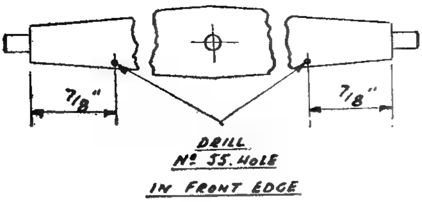
**Continued from page* 839, "*M.E.*," *Vol.* 102, *June 8th*, 1950.


L M S 11270
2'–3¼"


11 7/8"
12 1/2"
7 3/4"
4 1/4"
5
7 5/8"
9"

confirmed, order your copies straight away. There is nothing like having a nice clean drawing laid in front of you, and it does save the old MODEL ENGINEER copies from the ravages of greasy fingers.

What else have I been doing? Well, I have been working out every single detail of the



BRAKE STRETCHER.

cylinders, and proving everything as I went along. The story is a good one, and I am quite satisfied with all findings. Centred round this rather vital bit of the works, are the various alternative schemes to please all comers, and since I know the different tastes and beliefs of the many schools of thought, these alternative ideas have got to cover quite a lot of ground.

As a good starting off point, castings will be available in three different materials—gunmetal, cast-iron, and near-rustless Meehanite. Valve-chests, cylinder-covers and odd bits will be available in gunmetal, and I do not imagine anyone will want these parts in any other material. There is hardly any need to cast the slide-valves themselves, although enterprising supply firms may offer these off their own bat. The most important thing here is, the combination of metals to be used. Cast-iron and meehanite cylinders should have cast-iron or meehanite slide-valves. The alternative could be stainless-steel, gunmetal, duralumin, or brass in that order of preference.

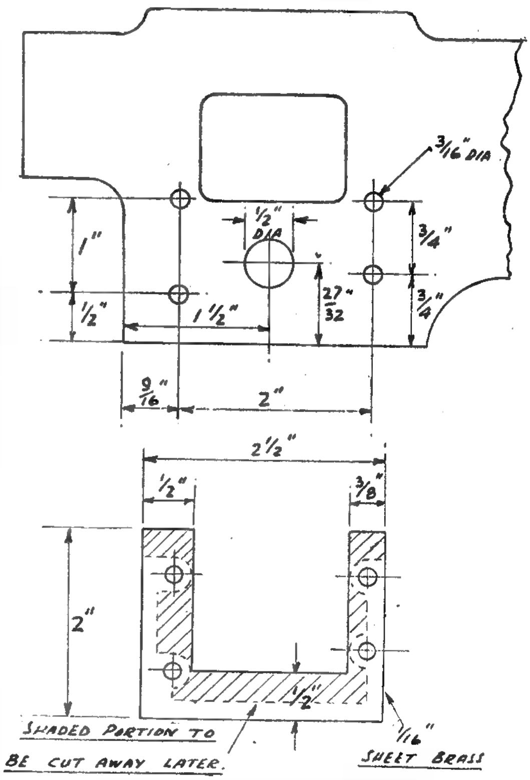
Gunmetal cylinders *could* have cast-iron valves, or stainless-steel, which makes an excellent combination, and after that, duralumin. Extruded brass is a fourth suggestion, but on no account should a gunmetal valve be used on a gunmetal port face. Cast-iron to cast-iron is one of the few exceptions to the rule of keeping away from similar metals in rubbing contact; steel to steel, when both parts are glass-hard, is another exception. However, as we are not likely to happen upon a brand of stainless-steel capable of being hardened (without losing its rustless properties) we might just as well forget it.

The cylinders will be $1\frac{3}{8}$ in. dia. by $1\frac{7}{8}$ in. stroke, which makes the overall cylinder length $2\frac{1}{2}$ in.

Bloodshed and Vituperation Dept.

We will now talk about port sizes, and see whether we can sort out some sort of reason from amongst the accumulated facts and fancies of the small locomotive past.

Once upon a time there were such things as the popularly termed "pinhole ports." These died a very certain death because they were hopelessly inefficient, and designers found that certain volumes of steam at certain pressures were needed to do so much work, and restricted passages meant loss of power for quite a number of reasons. Everybody was happy because they got results—flashing acceleration, snappy barks up the chimney, and loads of power; the ports got longer and longer, and the barks snappier and snappier. The long-travel valve had come to stay, because it meant a quick port opening and very little loitering round the edges—the prime cause of steam "wire-drawing." A few of the men who play with dummy valve-gear sets, made to work in the correct style, plus a little of the simplest type of calculation, soon revealed the honest and straightforward fact that so long as the *area* of the port uncovered at a *certain moment or point in the cycle of operation*, was sufficient for *all* steam needs in the cylinder,



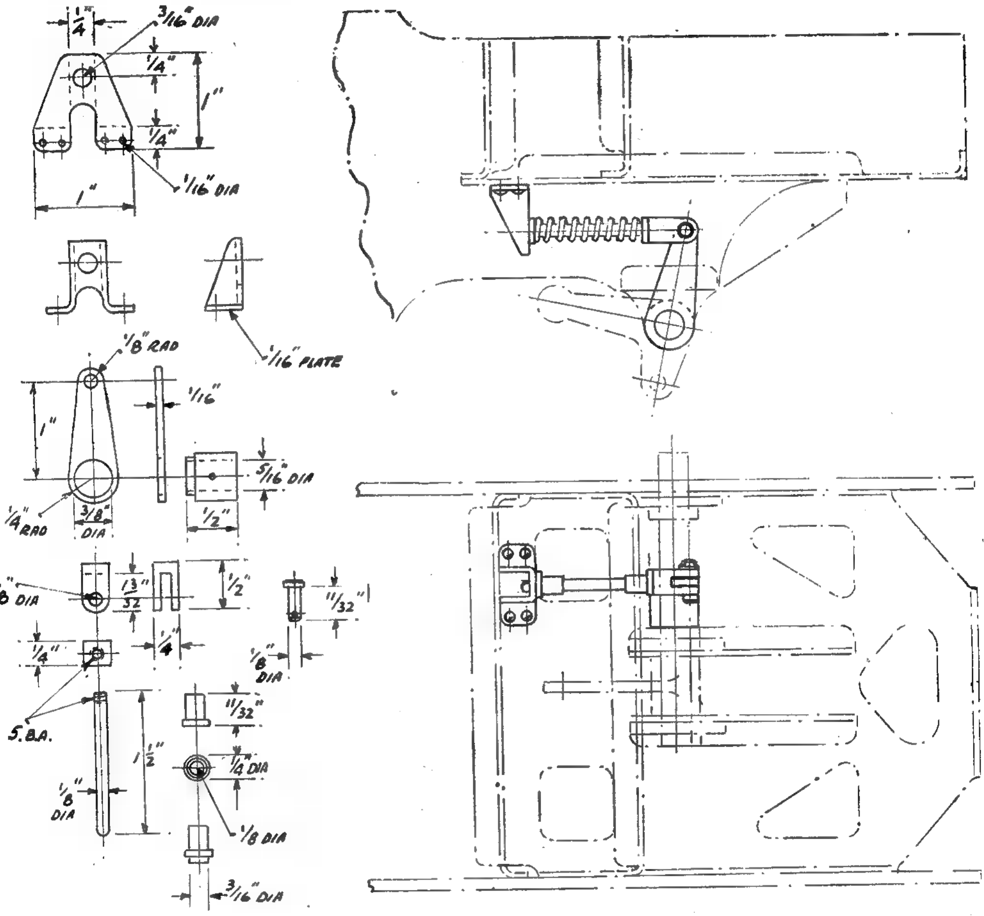
DRILLING FOR CYLINDER FIXING & JIG PLATE

then nothing could be gained by increasing the ports or passages. The first battles fought were based on the many interpretations of these needs, and all the issues of lap, lead, compression, steam waste, were thrown into the tussle to complicate the case still further, with the result that there were no clearly decided findings. Even the C.M.E.'s of the recent railway groups

continued to uphold different views, and to put them into practice, so it was no good looking to them for the last word.

So the long ports came and stayed—because they did do the job, and nobody really cared how much coal and water was consumed in the process. The small boiler, pioneered by friend "L.B.S.C.," proved that it could be made to steam copiously, and all honour to him; but it did, perhaps, make the valve-gear department a bit careless with port sizes.

the steam passages, and he was certainly on the right lines, in more than one sense. Back here, the small locomotive men, having got their desired performance, did not quite know where the port size question would end, and had no clear idea on how to determine port areas in relation to the *type of engine they were building*; I mention this because here we have a case in point—the building of an engine that is expected to haul a big load at a *very moderate speed*, so all the boys who were hoping to hare round the



ARRANGEMENT OF BRAKE CYLINDER RETURN SPRING.

Strangely enough, while this battle was going on, many engines were still being built with regulators having little more than 3/32 in. dia. steam ways, and standard $\frac{3}{16}$ in. and $\frac{1}{4}$ in. petrol pipe was being used between boiler and cylinders, to say nothing of the fierce, right-angled, gas-fitters' type of exhaust connections.

The great French locomotive designer, Chapelon, admitted to his friends that his greatest aid to all-round efficiency was the super-streamlining and smoothing of the inside surfaces of all

track at a scale 150 m.p.h. can go home now, and think it out. In all probability, they *will* be able to do speed turns, but they should not forget that the engine is not designed for this purpose.

Therefore, knowing the die-hard propensities of the locomotive-building fraternity at large, and the opposition I am simply *bound* to meet, I have allowed for two sizes in ports, the smaller of these being of *ample* dimensions, and the larger —more than ample.

But what is even more important, to my mind, is the provision of very adequate steam ways and pipes, right from the dome to the cylinders themselves. There just isn't any guesswork here, and anybody who cares to take the trouble to fit a separate steam pressure-gauge to the steamchest, and note the sustained drop in pressure whilst the engine is working, will soon appreciate how much of this pressure is lost through the fitting of inadequate steam ways.

I know *why* the small pipes have been fitted in the past; it is so much easier to bend $\frac{1}{4}$-in. copper pipe than it is to put a small-radius bend in a bit of $\frac{7}{16}$-in. pipe, without deforming it out of all recognition. It is interesting to note that purely local restrictions, such as the port face of the regulator and its connections, do not have such a retarding effect on the steam flow as the continuous strangling effect of the small-bore pipe; I'm not being dogmatic about it; just try it out for yourself, and you will soon be convinced.

In all other respects, the cylinders are orthodox, with the exception of the lubrication feed point, perhaps. This explains the centre hole to be drilled in the frames, in line with the centre of the cylinder bore. There will be a tiny hole, breaking into the very middle of the bore, and the feed pipe will run to this point.

When working, the incoming oil will have to contend with varying pressures, and at times when the piston is exhausting on one side, there will be practically no pressure to overcome, so that there will exist a state ensuring even distribution to both cylinders, which is much less chancy than the one feed via a tee connection or an entry of oil at the main steam pipe division. The oil will be blown up the steam passages on each exhaust stroke, impinging on the underside of the slide-valve and its cavity—very much in the place where it is needed.

I propose, therefore, to deal with the cylinders next in full detail, and to work back through the remaining motion parts so that the rest of the frame holes can be drilled until the "unit" is complete, and reassembled; I think you will then begin to feel that the engine is getting near the end of a very interesting and important phase.

(*To be continued*)

A Public Park Miniature Railway

(*Continued from page* 58)

home again. A complete track was thus built up in sections ready for laying down on the prepared site in the public park.

This 425-ft. track is roughly egg-shaped, a 50-ft. radius curve at one end, a 40-ft. radius curve at the other, joined by two 70-ft. straights. As the site is by no means level, the circuit includes about 100 ft. of cutting about 2 ft. deep and about 40 ft. of 2 ft. high banking; but this sort of thing lends interest to the run. In the cutting is a 9 ft. long tunnel which can be closed at each end by shutters, to form a covered lock-up for the engine and trucks. A water tank and an overhead footbridge complete the layout, although we hope, later, to add a signal box and signals.

My friend now had his boiler finished, and a splendid job he had made of it; he had spared no work on the various boiler fittings which, with the planished steel cleading, make the completed engine look very well indeed. Steam and hydraulic tests were very satisfactory indeed to us and to the insurance inspector who checked over the whole job in view of passenger-carrying in a public park.

Opening day at Strathaven Park was April 14th, and we hoped for a quiet opening in case there were any "teething" troubles, especially as the track had only been completed a few days previously, and the engine had never had a proper trial. Imagine our consternation when we learned on the morning of the opening that the "Strathaven Miniature Railway" would be opened at 3 p.m. by the district councillors, and that the local pipe band would be in attendance!

With only two trucks on, and with our fingers crossed, we anxiously waited for the "all clear" after the opening speeches were over. We need not have worried; the engine easily walked off with its two trucks packed with kiddies. Since that day, we have always run the three trucks, usually packed to capacity, and we have not had an anxious moment from engine, permanent way or rolling stock.

Since the above date, we have run a service every Saturday afternoon, and every afternoon during the Glasgow holiday week. Our busiest day was one when, from 2 p.m. till 8 p.m., we could not beat the queue and carried 1,548 people.

Perhaps our method of raising steam may be of interest. We use a hand-blower (ex-portable forge) which we fit with its suction side to the engine's chimney; steam can be raised from cold water in 12 to 15 minutes.

IN THE WORKSHOP

by "Duplex"

67*—Pipe Fittings

THE making of union nuts to fit the union bodies described in the previous article is a straightforward turning operation, requiring no elaborate tool equipment. For use with a flared pipe, which has also been described at some length previously, the bottom of the nut bore is made cone-shaped. Machined nipples, on the other hand, require nuts formed with a square shoulder to press against a corresponding abutment face formed on the nipple itself.

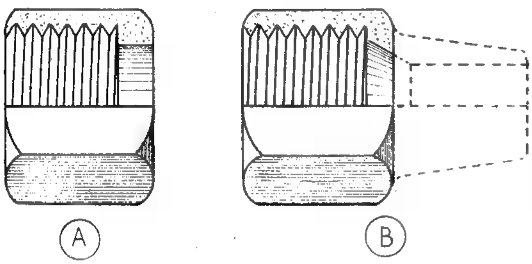


Fig. 1.

The two forms of union nuts are depicted in Fig. 1A and B, and it will be clear that, for the most part, similar machining methods will serve for the two varieties. It will be convenient, therefore, at this stage, to consider the machining of both forms of nuts.

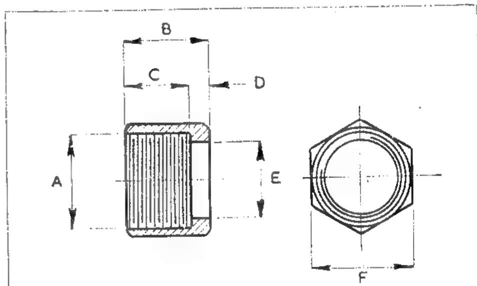
It will be observed that, as indicated by the dotted outline, there are two forms of internally coned nuts. The short nut is used for solderless unions fitted with loose olive nipples, and has a somewhat greater thickness of metal at the shoulder than is shown in the drawing, but the long variety is usually employed with flare-type joints, as it gives greater support to the pipe at the point of junction with the body.

It should also be noted that cone angles of either 90 deg. or 60 deg. are used commercially for this form of nut.

The dimensions of standard union nuts and nipples for $\frac{1}{8}$-in., $\frac{1}{4}$-in. and $\frac{3}{8}$-in. B.S.P. threads are shown in Figs. 2 and 3, while Fig. 4 indicates the sequence of machining operations for making these nuts, and it must again be emphasised that all the dimensions should be checked against a known union nut or body, as different makes of these components vary in size.

Machining Union Nuts

After a short length of hexagon brass rod, of the right size across the flats, has been gripped in the self-centring chuck, the bar is faced with a right-hand knife tool mounted in the top-slide toolpost, operation 1. The part is then centre drilled, operation 2, and drilled to the correct clearing size to allow the pipe to pass, operation 3. The drill used for this purpose must be fed in to a depth which will allow the nut to be parted off cleanly. The drill in the tailstock chuck is now changed for one of the correct size to form the tapping hole, operation 4. The hold afforded by a thread of full depth, as is explained in *Screwthreading and Screw Cutting* published by Messrs. Percival Marshall & Co., is not necessary here. The correct size of tap is now mounted in the tailstock drill chuck and the nut is threaded until the tap is felt to bottom against the shoulder formed by the tapping drill, operation 5. The type of tap used for this operation is that known as a second, for the small depth of the hole will not allow the threads of a taper tap to engage, and it is for this reason that the drilled hole should be of a size that will permit



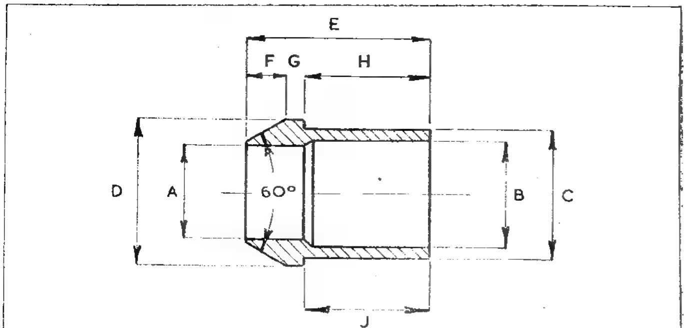
NOMINAL SIZE	DIA OVER THREAD	THREADS PER INCH	B	C	D	E	F
IN.	IN.		IN.	IN.	IN.	IN.	IN.
$\frac{1}{8}$ B.S.P	.383	28	.320	.260	.060	.252	.445
$\frac{1}{4}$ B.S.P	.518	19	.450	.350	.100	.380	.600
$\frac{3}{8}$ B.S.P	.656	19	.500	.400	.100	.505	.750

Fig. 2. *Details of the most usually used sizes of union nuts*

the tap to cut freely. Some second taps have rather more lead than others; and these should be followed by a plug tap to ensure that the thread extends far enough to enable the nipple to be gripped firmly.

In many commercially made unions it has been found that the shoulder in the nut is not perfectly square, as it has been formed by a drill ground with a nearly flat point. Rather

*Continued from page 961, "M.E.," Vol. 102, June 29th, 1950.



OUTSIDE DIAMETER OF PIPE	NOMINAL SIZE OF UNION TO FIT	A	B	C	D	E	F	G	H	J
IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1/8	1/8 BSP	.100	.128	.246	.327	.438	.110	.040	.288	.250
3/16	1/8 BSP	.156	.190							
1/4	1/4 BSP	.219	.253	.375	.437	.660	.130	.060	.470	.420
5/16	1/4 BSP	.253	.315							
3/8	3/8 BSP	.344	.378	.500	.575	.777	.187	.090	.500	.450

Fig. 3.

than grind a drill specially for this purpose, however, it is preferable to make a short D-bit of the same diameter as the tapping drill to enable the shoulder to be cut squarely. The D-bit should be fitted with an adjustable collar to act as a depth stop. This shouldering operation should immediately follow No. 4, and preceed the tapping of the hole.

The making of D-bits has already been fully described in these articles and appears also in Vol. I of *In the Workshop*; further reference to the subject, here, is, therefore unnecessary. Nuts which require a 60 deg. internal cone may be machined with a centre-drill or preferably with a coned reamer fitted with a collar to serve as a depth stop. This will enable several nuts to be machined identically, as the use of the D-bit depthing collar in an earlier operation will ensure that the start of the coned holes is the same distance from the mouth of the nut in every case. The coned reamer fitted with a depthing collar and the form of D-bit previously mentioned are illustrated in Fig. 5.

Making Pipe Nipples

The machining operations for producing the nipples, of the sizes listed in Fig. 3, are shown diagrammatically in Fig. 6. It will be seen that, in the main, the tooling is the same as for the union nuts already described.

After a piece of brass rod of suitable size has been set in the self-centring chuck, the end is faced with a right-hand knife tool mounted on the top-slide, operation 1. The same tool is next used to turn the diameters *C* and *D*, listed in Fig. 3, operations 2 and 3. A Slocombe centre drill is then gripped in the tailstock chuck and the work is centred, operation 4. The centre drill is now changed for the drill required to form the hole *A*, operation 5, and is fed in to a depth that will ensure that, subsequently, the nipple is parted off cleanly.

Changing this drill for the larger of the two shown in the illustration, the hole, dimension *B*, which forms the pipe seating is now drilled to the depth given in the drawings, operation 6. This leaves but two further operations to complete the machining.

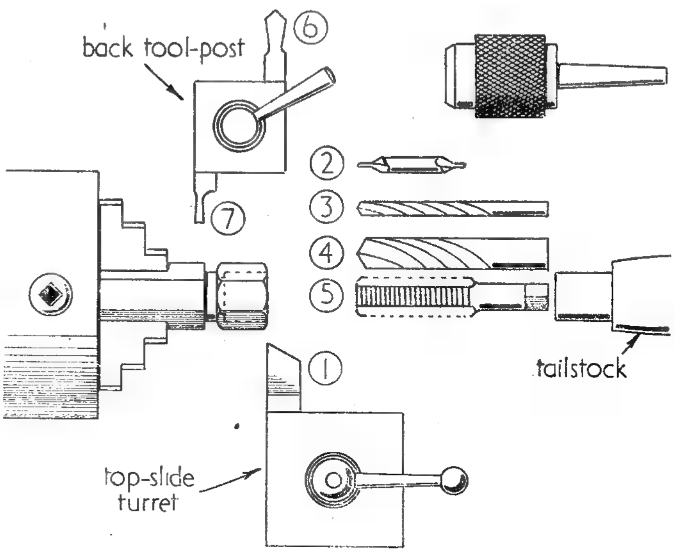


Fig. 4. *Sequence of operations for making union nuts*

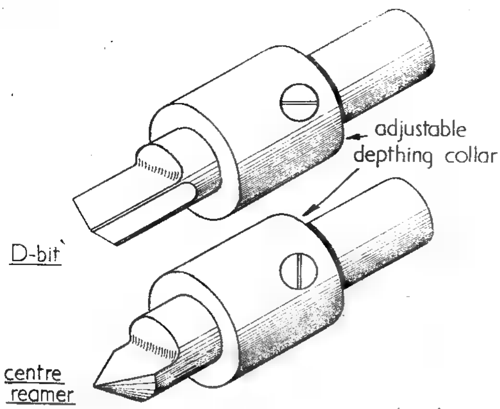


Fig. 5.

The first of these forms the 60 deg. cone on the nose of the nipple and is best carried out with a form tool mounted, as seen in the illustration, in the back tool-post. The tool is fed into the work until the small land, shown as dimension *G*, in Fig. 3, has been produced in accordance with the measurements given, operation 7. A note of warning must be sounded at this point; the nose of the form tool must be set at a distance from the shoulder of the nipple equal to *F* plus *G*, in Fig. 3, or the work may inadvertently be parted-off.

The turret of the back toolpost is now rotated and the parting tool brought up to the work for the final operation of parting-off, operation 8.

As in the previous series of operations for forming the union nut, measurement with a rule is sufficiently accurate. The measurement of the depth of holes drilled from the tailstock has already been described in this series of articles and appears also in Vol. I of *In the Workshop*. One of the methods shown therein should therefore be used to determine the depth of the hole drilled in operation 6.

Whilst the description of the work of machining both nipples and union nuts has been exemplified by the three commercial sizes most commonly used, it must be emphasised that the same prodecure can, however, be employed for making

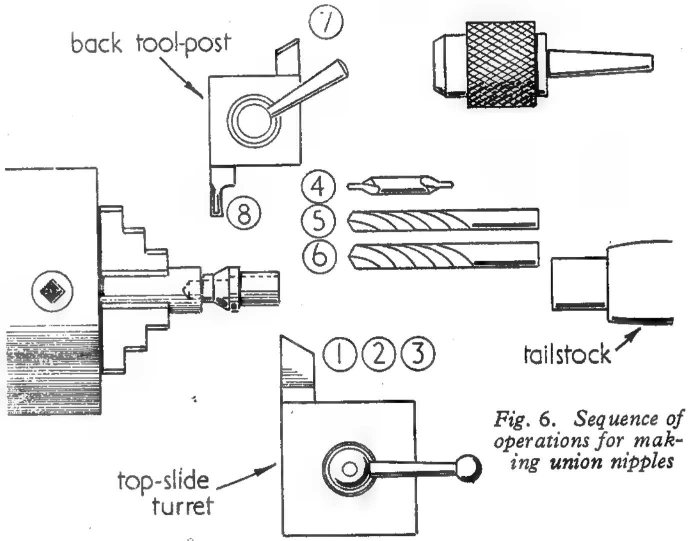


Fig. 6. Sequence of operations for making union nipples

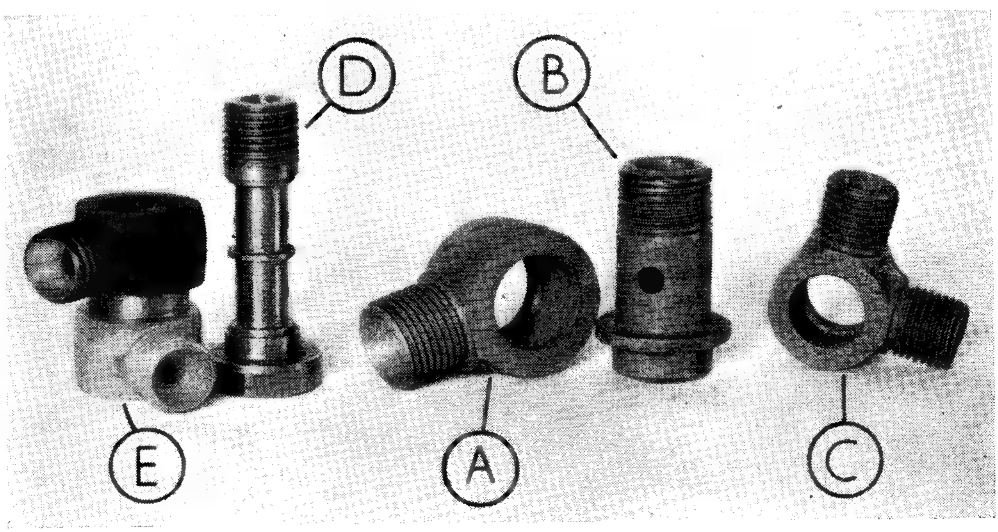


Fig. 7. Banjo unions

smaller unions. The methods used for making larger unions will, of course, need some detail modification. For example, the tapping of a large union nut in the lathe is hardly practicable and a screw-cutting operation must be employed for this purpose ; again, the forming of a pipe

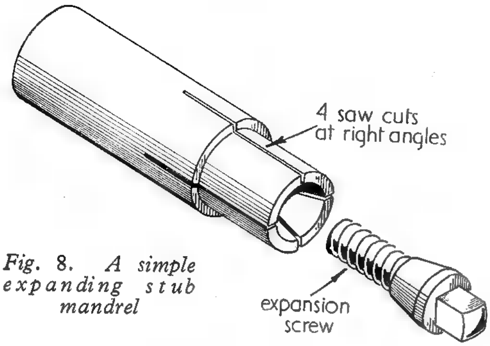


Fig. 8. A simple expanding stub mandrel

seating in a large nipple will almost certainly involve an additional boring operation after drilling to ensure that the nipple is a good fit on the pipe.

Banjo Unions

A form of union much used in automobile and aircraft practice is the banjo type of which some examples are shown in Fig. 7. This form of union has the great advantage of avoiding sharp bends in the piping when connections have to be made in confined spaces. As will be seen at *A*, in the illustration, a simple banjo union consists of the banjo body itself to which one of the various types of union nut and nipple previously described may be attached, and a hollow or barrel screw *B*, having either two spanner flats or a hexagon head, by means of which the banjo is pulled against a flat abutment seating. Red fibre washers are placed on either side of the banjo to seal the joints.

As will be clear from the illustration, the banjo body is chambered and cross-holes are drilled in the barrel screw to enable the contents of the pipe to be conveyed to or from the part connected.

A further advantage of this type of union is that more than one pipe connection can be made at any point. For example, the banjo shown at *C* allows two separate connections to be made, while two such banjos, if used with the screw seen at *D*, would allow four independent connections. The method whereby two unions are attached to a single screw will be clearly seen at *E*, where it will be observed that a distance-piece separates the two banjo bodies, and is held in axial alignment by the collar machined on the long screw seen at *D*. Fibre washers are, of course, fitted to all joints to maintain a seal.

Making Banjo Unions

A competent authority has pointed out elsewhere that the banjo union is only satisfactory if accurately made, and to this statement a further proviso must be added. It is absolutely essential that the hole for the hollow screw is tapped squarely, otherwise the banjo cannot seat properly nor can the washers form a seal, for the pressure applied to them is not uniform.

The banjo union parts seen in the illustration, a few out of many hundreds of similar components, were made with the aid of expensive jigs and tools which ensured both interchangeability and rapidity of production. These unions were machined mainly from light alloy stampings and bar material, with the exception of

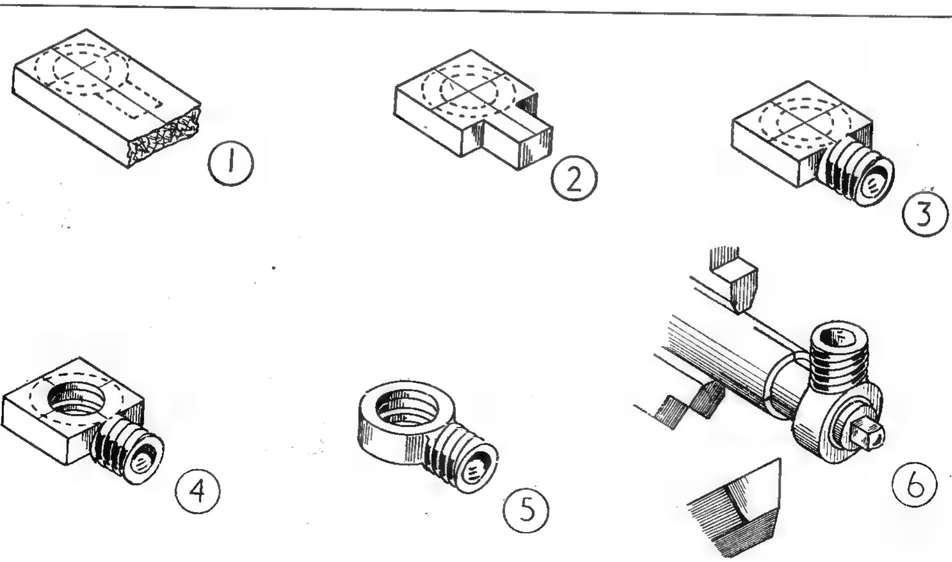


Fig. 9. Steps in the making of a banjo union body

the long screw *D* which is made of stainless-steel.

When commercial sized union parts are needed they will doubtless be purchased, but for those who require to make a single, or at most two or three sets of small parts, there is no need for any special tooling fixtures other than a stub mandrel upon which the banjo bodies are mounted for machining their contact faces to make sure that these are parallel. As there may be a slight variation, it is advisable to make for this purpose a simple expanding stub mandrel, of the type shown in Fig. 8.

The body of the device consists of a short length of mild-steel of suitable diameter having one end turned down to fit the bore of the banjo. The turned portion should be some ¾ in. long. The body is taper bored, drilled and tapped to accommodate the expansion cone-screw seen in the illustration and is then split by four saw cuts at right-angles to one another. When mounting the banjo on the mandrel it should be allowed just to overlap the end so that a facing cut can be taken across without the tool cutting into the fixture itself. An expanding mandrel of this form is useful for a variety of work, but it is not possible to give here the full dimensions for making the device as these will, naturally, depend upon the size of the work to be held.

In the illustration, Fig. 9, the method of producing a banjo body is depicted. The first operation consists in marking-out the outline of the part on a piece of flat drawn brass rod of suitable thickness. Saw cuts are then made to cut roughly to shape the portion of the component later to be threaded, operation 2. This part is then filed square. The work is next mounted in the four-jaw chuck, operation 3, and the squared portion is set to run truly by means of a test indicator. It is not necessary for the indicator to give exactly the same readings on all faces, and the part will be correctly set when identical readings are obtained on opposite faces of the work.

The component is then turned, threaded for the union nut, drilled and finally internally coned.

When, in operation 4, the part is mounted in the four-jaw chuck for machining the bore, it is advisable to interpose a piece of soft packing between the threaded portion of the banjo and the chuck jaw, to prevent damage.

Care must be taken to see that the component is mounted squarely, otherwise a considerable amount of metal may have to be removed when the banjo is faced on the stub mandrel at a later stage.

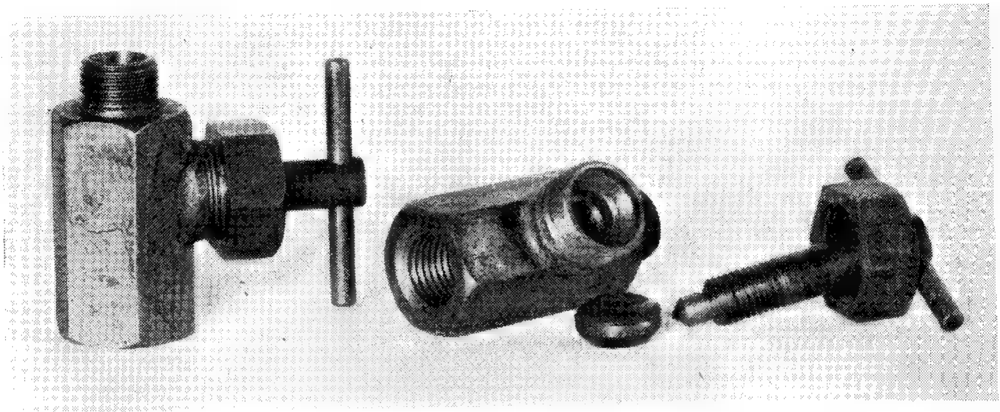


Fig. 10. *Two simple taps*

The chambering operation is best performed with a small boring tool with a square cutting edge.

If several banjo union bodies are to be made, it may be profitable to ream the bores in the lathe to ensure uniformity, and thus facilitate the subsequent mounting of the parts on the stub mandrel.

The union is now filed to shape, operation 5, and when the work is gripped in the bench vice soft clams must be used to protect the machined surfaces from damage.

Finally, operation 6, the banjo is mounted on the stub mandrel in the way previously described, and both bolting faces are machined in turn to ensure that they are parallel and at right-angles to the bore.

Taps

No article on the subject of pipe fittings would be complete without some mention of taps. Their various forms, however, are many and full information about the commercial types may be obtained from the catalogues of manufacturers such as Messrs. Rotherhams, of Coventry. It is therefore proposed to omit any account of these commercial patterns and to describe only a type which is especially suitable for production in the small workshop.

Two of these taps may be seen in Fig. 10, one being in the dismantled state to show its various parts. The dimensional details for constructing the tap are given in Fig. 11B.

The body *A* is made from hexagon brass bar

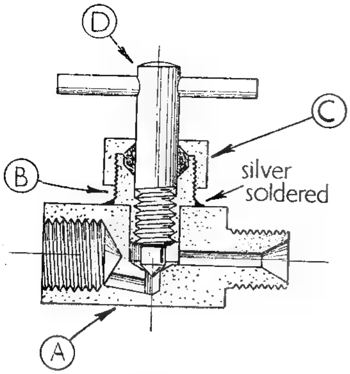


Fig. 11A. *Sectional view of a simple tap*

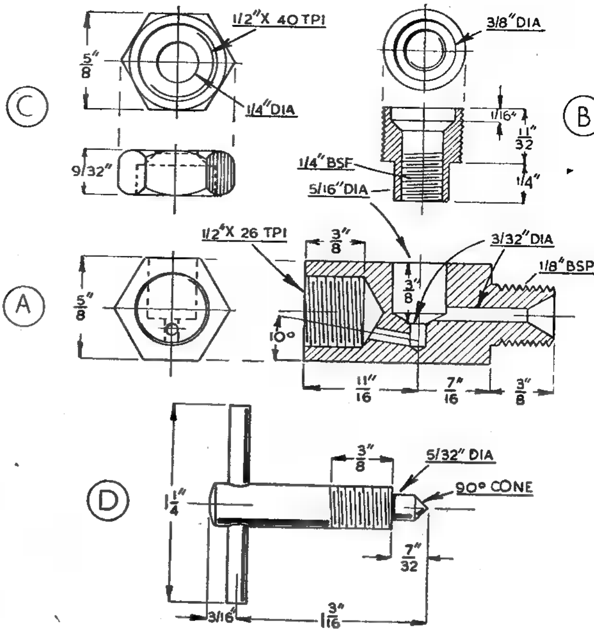


Fig. 11B. *Details of the tap*

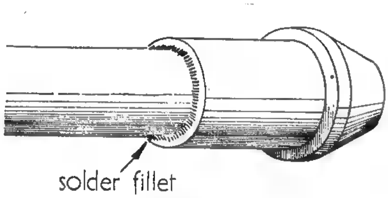


Fig. 12.

and has ■ lug forming the tap gland seating silver-soldered in. As will be seen from the sectional drawing, Fig. 11A, a communication hole is drilled off-centre and at an angle to allow fluid to reach the needle valve *B* and so to pass through the tap. The cork gland packing is compressed between the gland nut *C* and the seating, both of which are coned internally.

From the machining standpoint there is but little difficulty, as all operations are straightforward. The making of a simple drilling jig to ensure the correct alignment of the communication hole is, however, advised, for it is clearly impossible to mark the centre for this hole and to drill it by ordinary methods. All that is needed is ■ piece of brass rod, threaded 1/8 in. B.S.P. and having a 3/32 in. hole made in it at the correct angle. The piece of rod is then screwed into the body of the tap, which is set up for drilling by aligning the hole in the jig with a drill of the correct size mounted in the drilling machine. When the work has been firmly clamped in the machine vice, the drilling machine is started and the drill is fed in till it breaks into the cavity under the needle valve.

The machining of the remainder of the parts is quite straightforward, and requires no detailed explanation. The operations for making the gland nut are the same as those used when forming union nuts, while the turning of the needle valve, and the drilling operations for fitting the cross handle are all examples of work that has previously been described at length.

Soldering and Brazing Union Nipples

As this work is often indifferently carried out, ■ few words on the subject will not, perhaps, be out of place here.

To begin with, the parts must be perfectly clean and free from grease; this applies to both soldered or brazed joints. When soldering, it is not necessary to tin both the nipple and the pipe separately, for the application of ■ good cored solder such as Ersin Multicore, will result in the whole joint being properly fluxed and the solder will flow to form a good fillet, as shown in Fig. 12. The same result can be obtained by painting the inside of the nipple and the end of the pipe with Fryolux paint, which is ■ proprietary compound of finely divided solder grains and a powerful fluxing agent.

Experience has shown that a solder having a high tin content gives the best finish to the work, as it leaves an almost permanent silver colouring to the joint.

There is no necessity to apply excessive heat to the work; indeed, a laboratory spirit lamp will be sufficient for most pipe soldering operations.

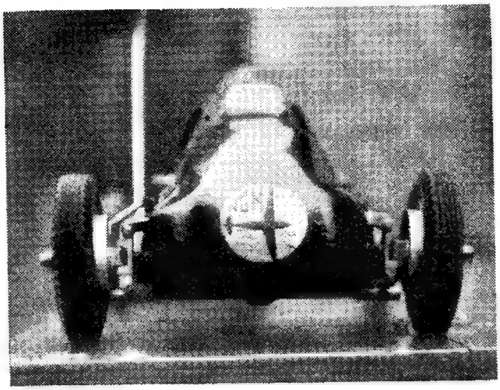
The application of an excessive amount of solder must also be avoided, for this will inevitably lead to untidiness and be the cause of the insightly filed-up joints so often seen.

Brazed or silver-soldered joints are best made with the pipe standing vertically in the nipple upon a piece of firebrick. The work is supported by ■ second brick against which the work leans.

The work should be well cleaned and the pipe and nipple put together with flux before heat is applied. A satisfactory hard solder for the purpose is Messrs. Johnson, Mathey's "Easi-flow," This material, as the name implies, flows freely and at ■ comparatively low temperature. The makers will provide full instructions for using it.

A Home-Built 5 c.c. Wildcat-Engined Car

by Bernard Walker



MY 5 c.c. car may be of interest, because it was entirely home-constructed with the exception of the tyres and ■ couple of ball-races.

The engine, 5 c.c. compression - ignition "Wildcat" made from the early sand-castings, occupied 60 hours. It started easily from the word "go."

For the chassis, I used a piece of sheet alloy beaten into channel - sections, which tapered towards the back, the gearbox being bolted in rigidly to act as the main cross-member. The engine is centrally mounted and drives to the gearbox, via a clutch of my own design containing two alloy shoes with leather inserts. This clutch engages smoothly, and is well suited to the c.i. engine.

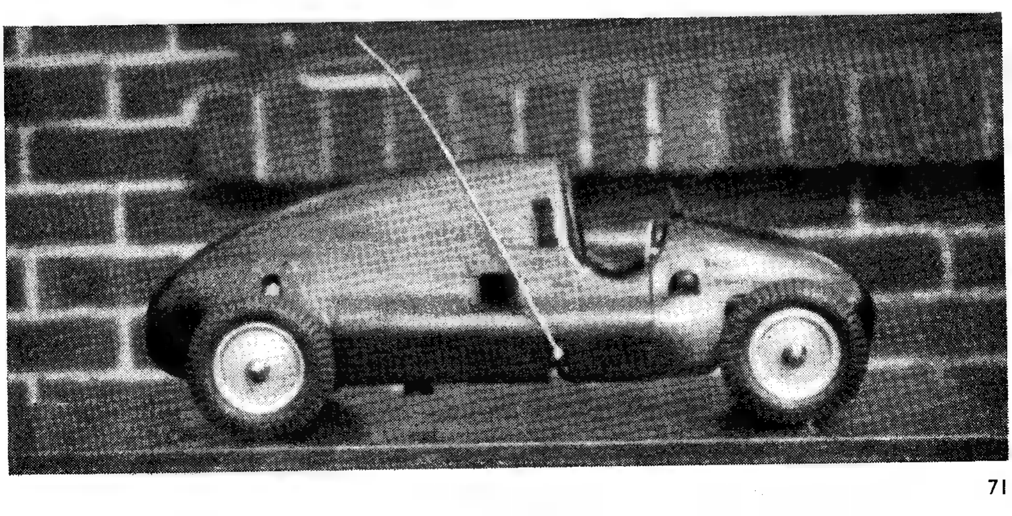
The gearbox was machined from brass bar and contains steel bevels, giving a ratio of 2 : 1, the shafts revolving in plain bearings.

Rear suspension is independent, four equal-length wishbones carrying each wheel, and being linked to cylinders which originally were genuine hydraulic cylinders, but they now contain coil springs because the fluid gave too harsh an action. The wheels remain vertical under deflection and the drive is taken to them through universally-jointed rods.

At the front the wheels are carried by equal-length wishbones pivoted on unequal centres and controlled by coil springs. Proper steering is incorporated and there is castor-action which increases as the springs are deflected. A worm and wheel turn the front road wheels through spring-loaded ball and socket jointed track rod and drag link, small set-screws locking the stub-axles for racing purposes.

I cast the road wheels myself, from scrap aluminium, and "Bostic" secures the scale Dunlop "Fort" tyres to them most effectively. A knock-off fuel-cut-off of the usual kind is fitted and the body, on "M.C.N." Special lines, was carved from ■ piece of balsa wood and finished in British racing green. It carries two exhaust stubs, two air scoops to direct cool air on the cylinder, an aero-screen, and the N.G.M. transfer to represent ■ radiator grille. Incidentally, I am a keen member of the Ossett M.C.C.

My car has a wheelbase of $11\frac{1}{2}$ in., is $16\frac{1}{2}$ in. long, has a front track of $6\frac{1}{2}$ in., a rear track of $7\frac{1}{2}$ in. and uses $3\frac{3}{16}$ in. diameter wheels, the weight coming out at 4 lb. 4 oz. Correct Ackermann steering is employed, and all machining was carried out on ■ 30-year old Drummond round bed lathe.



Walschaerts Gear for "Pamela"

by "L.B.S.C."

As mentioned in the opening instalment, we had an imaginary search around the stores at Crewe and Derby, to see what we could find in the way of valve gear parts, for use in converting the ex-spam-can into an efficient and sturdy engine. Here you see the result. By slightly lengthening the piston-rods and valve-spindles, and shifting the guide-bar brackets clear of the larger coupled wheels, the valve gear of the ubiquitous class 5 (our *Doris*) works in just right, and saves British Railways the expense of a fresh lot of patterns, castings, and what haven't you; so let us go right ahead and fit them. As I described this valve gear in full detail, fairly recently, there should be no need to repeat the full ritual; so I'll just run through it briefly, and note one or two minor details which I have amended, to make the job easier.

First, the girders carrying the expansion links. Two or three builders of *Doris* complained that the small bracket carrying the leading end of the extension bars (the bars are needed to clear the leading coupled wheels) was specified to be set at right angles to the bars; whilst the guide bar bracket, to which the other one was bolted, was on a slight angle, so that the bolting faces didn't match up. Now I give all followers of these notes credit for having their full share of what is commonly termed "gumption," and it was perfectly obvious to all (except the complainants mentioned), that a few judicious strokes of a file on the side of the bracket carrying the bars, would have bevelled it sufficiently to match the slope of the guide-bar bracket; so they just did it, exactly as I intended. However, it is your humble servant's aim to try to please as many as possible; so in the present instance, having a little more room, I have shown the bracket carrying the extension bars, itself extended, and bolted to the frame instead of the guide-bar bracket. All who prefer to fit the arrangement specified for *Doris*, can of course do so. Leave the outer girder or bar, full length; and when erecting, cut it off flush with the guide-bar bracket at the point where it overlaps (see plan view) and put a couple of 9 B.A. roundhead screws through. Then I hope everybody will be happy!

The centre stay is made in one piece; no bits of angle are necessary. It can be made from a casting, or from a block of steel, bronze, or even brass if no better material is available. Saw and file to the shape shown; slot out the $\frac{1}{4}$ in. clearance for the radius rod, then cut the two $\frac{1}{16}$ in. slots for the extension bars. The sides can be bevelled off, as shown in the plan, for appearance sake, or they can be milled to look like pieces of angle, as fitted to *Doris*. The rear bracket is the same as for *Doris*, but as the reach rod is different, a clearance $\frac{3}{8}$ in. wide and $\frac{1}{4}$ in. deep is milled or filed in it, to allow the fork connection to clear. The side plates are cut out, attached to the brackets and stay as shown, and all the joints brazed or silver-soldered, as described for *Doris*, so that it forms a single unit.

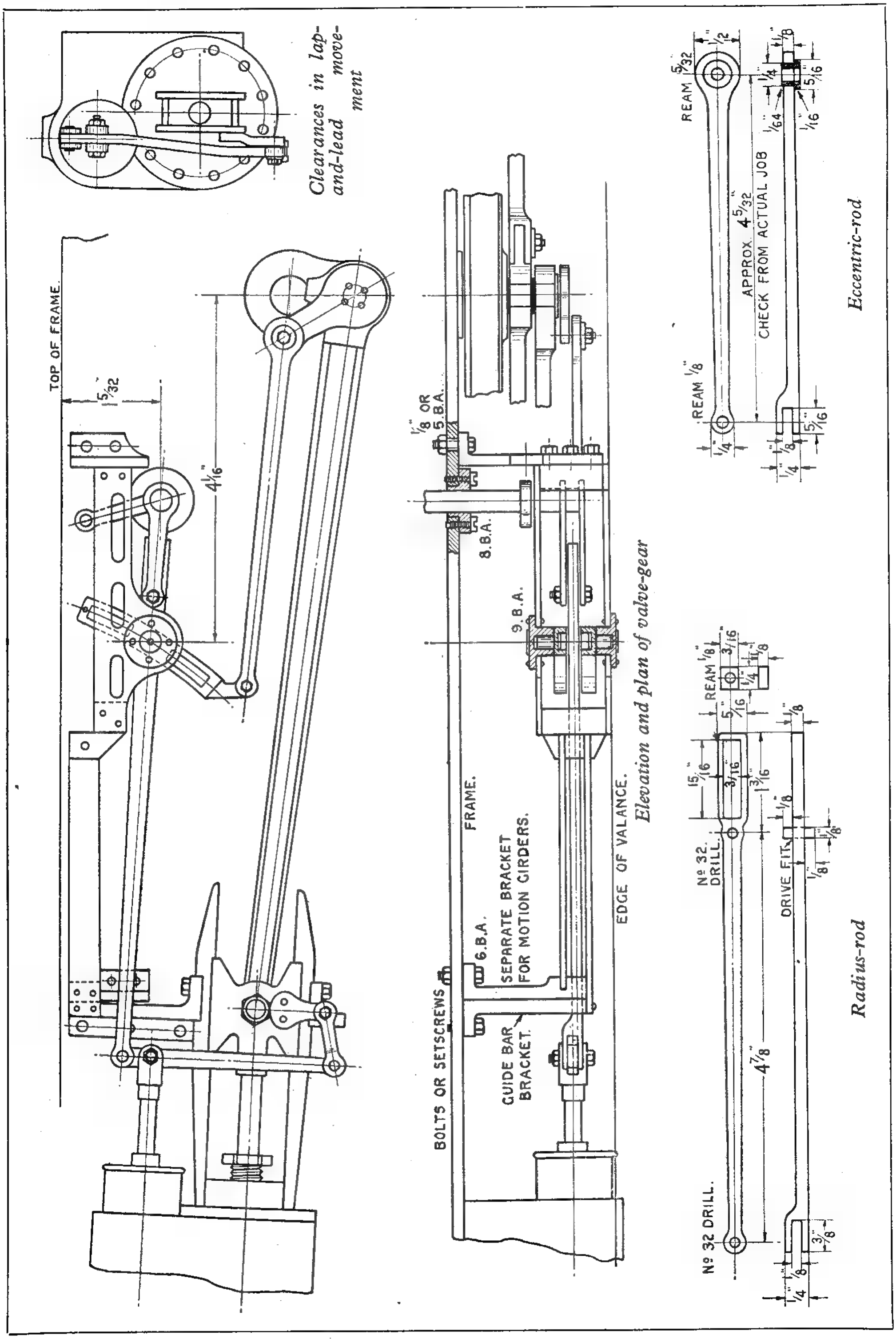
Lap-and-Lead Movement

The only difference to the parts specified for *Doris*, is the union link. Instead of having a fork at each end, it has only one, to embrace the bottom of the combination lever, which is a plain tapered bar with $\frac{1}{8}$ in. offset, as shown. The back end of the union link has a plain eye, which should be case-hardened. This fits over the pin at the bottom of the drop arm on the crosshead, and is secured by a nut and washer. Beginners and inexperienced readers who want full details of machining and fitting the above, and also the following parts, should read up the notes for building *Tich*, in which every job is fully detailed out for their express benefit.

Links and Rods

With the exception of the return crank, which is shorter, owing to the shorter piston stroke, all the parts are made and erected exactly as described for *Doris*. Briefly, the expansion links, which are of box type, can be made by bending a piece of $\frac{3}{8}$ in. by $\frac{1}{4}$ in. steel into a curve of $4\frac{7}{8}$ in. radius, measured at the centre line. This is soldered to a piece of stout brass sheet, bolted to the faceplate, faced off, and a groove $\frac{1}{8}$ in. deep and $\frac{3}{16}$ in. wide formed in it with a parting tool. Inside and outside are turned to leave $\frac{1}{16}$ in. each side of groove. The piece is then reversed, and the back faced off, to leave the overall thickness $\frac{3}{16}$ in. Melt it off the turning plate, and cut off four pieces for the link sections. Slot through as shown, by drilling and filing, then fit trunnion pins, tail, and distance pieces. Before fitting the trunnions (of 5/32 in. silver-steel) slightly countersink the tapped holes, at the bottom of the grooves. After screwing the pins tightly home, burr over the ends into the countersinks, and file flush. They won't come loose after that treatment!

Before assembling the two halves of the link, make the radius rods, and fit the link dieblocks to them; then put the dieblocks in the curved grooves in the links, as you place the two halves of the link together. The halves can be temporarily attached at top and bottom, by two weeny rivets made from a bit of domestic blanket pin (No. 57 drill) and the joints then silver-soldered; this job is easy enough if you keep the dieblocks at the opposite end of the link, doing each end separately. Be very sparing with the silver-solder. Another way to do the job, is first to make up the links complete; fit the dieblocks to the grooves before assembly, so as to make certain they fit all right, but take them out whilst brazing or silver-soldering the



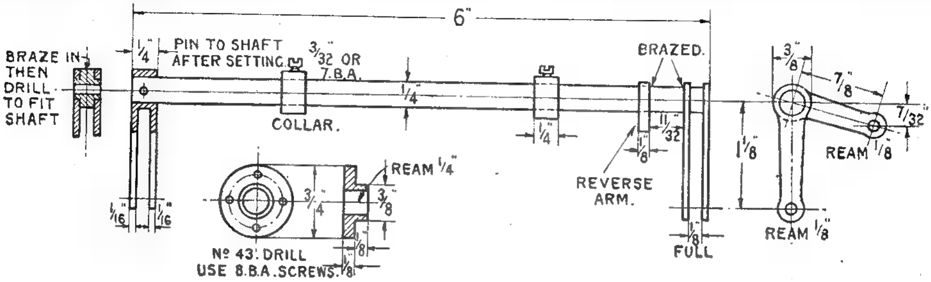
Clearances in lap-and-lead movement

Elevation and plan of valve-gear

Eccentric-rod

Radius-rod

two halves of each link together. After cleaning up the links, the dieblocks are inserted in the slot between them—they will just go through, ■ they are $\frac{1}{8}$ in. thick, and the slot is $\frac{1}{8}$ in. full—and wangled into the grooves. Line them up through one of the openings in the side of the link; put the radius rod between them, and squeeze in the pin through the lot. A nice little bit of jerrywangling, says you; but it is perfectly easy, and avoids any chance of accidentally silver-soldering the blocks into the grooves, automatically giving the exact length of the rods. The process was fully detailed in the instructions for *Tich*. Briefly, jam up the expansion link temporarily in such ■ position that the dieblocks can be run from top to bottom without moving the valve spindle, first setting the main crank on front dead centre. Then take the distance, with dividers, from centre of link tail eye to centre of return crankpin. Put main crank ■■ back dead centre, apply the dividers as before, and if the distances don't tally, shift the return



Reversing or weighbar shaft

which might easily be done by an inexperienced operator. Yet another way would be to assemble the two halves of the link, with ■ screw instead of ■ rivet at the top, and braze or silver-solder the tail end only. The top distance piece could then be removed, the dieblocks (complete with the radius rods) inserted, and the screw replaced. As the drive is at the bottom, where the tail is brazed to the links, they would work all right even if left entirely unconnected at the top; but it is advisable to fit the top distance piece and hold it with a screw, to prevent the two sides from trying to close in and nip the radius rod. One 9 B.A., or two 11 or even 12 B.A., would be quite sufficient to hold the distance piece and link ends together, the latter being equal to $\frac{3}{8}$-in. bolts on a full-sized engine.

The return cranks are slightly shorter than those on *Doris*, otherwise they are the same. Countersink the crankpin hole at the back, and after squeezing in the pin, rivet it over into the countersink, and file flush. Squeeze them on to the ends of the main crankpins, setting "by eye" at first kick-off; then assemble the rest of the gear as described for *Doris* and *Tich*. Attach radius rod and union link to combination lever, by bits of $\frac{1}{8}$-in. silver-steel squeezed through the holes in the forks, and filed flush. Put the expansion links in place, with the trunnions opposite the bearing holes, then put the bearing bushes over them from the outsides (see plan view), and secure with four 9-B.A. screws (round-head for preference) in each flange. The eye of the union link fits over the pin in the crosshead arm, and is fixed by ■ commercial nut and washer; ■ bolt made from $\frac{1}{8}$-in. silver-steel, reduced at both ends to 3/32 in., screwed and nutted, goes through valve fork and combination lever.

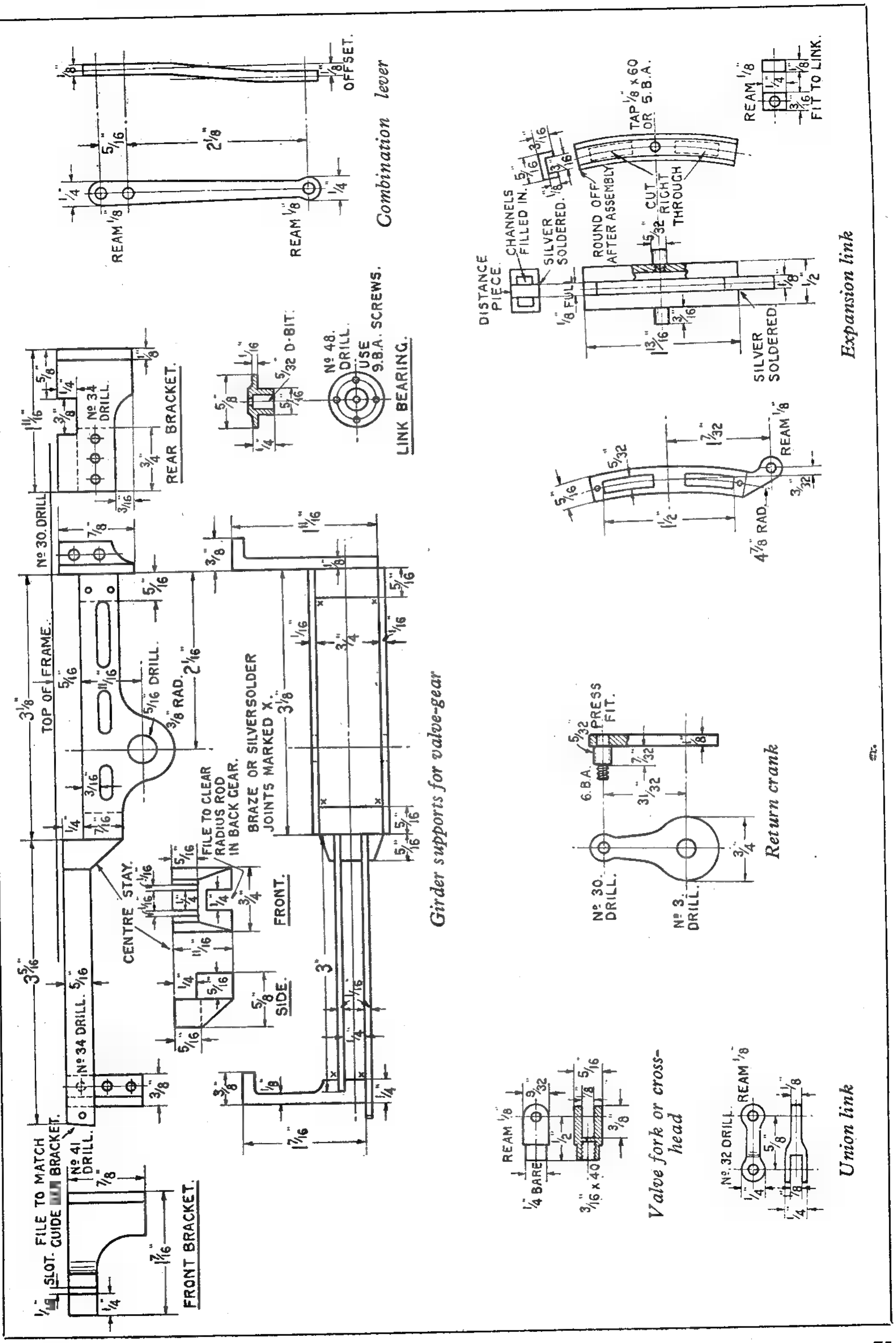
A Gentle Reminder

Don't forget that before making the eccentric-rods, the return cranks should be set, this process crank half the difference. When distances tally exactly on front and back centres, return cranks are O.K. Fix cranks with four screwed pins, $\frac{1}{16}$ in. or 10 B.A. half in crank and half in pin (see elevation) and make your eccentric rods to the length between the divider points. The larger ends of rods are bushed as shown, and the fork attached to link tail by ■ $\frac{1}{8}$-in. bolt, same as in valve fork.

Reversing Arrangements

The reverse or weighbar shaft is the same ■ specified for *Doris*, a 6 in. length of $\frac{1}{4}$ in. round steel adorned with two double lifting arms, ■ reversing arm, and two collars. The whole doings runs in two flanged bearings turned from bronze or gunmetal rod $\frac{3}{4}$ in. diameter, ■ shown in the small detail sketch, put through the $\frac{3}{8}$-in. holes already in frame, and attached by four 8-B.A. screws through the flanges. The lifting arms are filed up from $\frac{1}{16}$-in. × $\frac{3}{8}$-in. steel, and the reverse arm from $\frac{1}{8}$-in. × $\frac{3}{8}$-in. ditto, one pair of lifting arms and the reverse arm being brazed on one end as shown. The lifting arms at the other end are brazed on to ■ distance-piece with ■ pilot hole through it, see detail sketch; after which, the hole is enlarged to $\frac{1}{4}$ in., the arm fitted to the shaft, and pinned after setting. The collars are $\frac{1}{4}$ in. slices of $\frac{1}{2}$ in. diameter rod, drilled $\frac{1}{4}$ in. and furnished with a setscrew.

As with *Doris*, the shaft is poked through the right-hand bearing, the two collars put on between frames, shaft then carried through left bearing, and the other lifting arm put on. The dieblocks are put in the slots in the radius rods, the lifting arms brought up on each side of them, and bolts similar to those in the valve spindle forks put through the lot. The detachable arm is then set on the shaft so that both dieblocks are in the middle of the expansion links at the same time; then drill ■ No. 43 hole clean through boss of lifting arm, and end of reverse shaft,



Combination lever

Expansion link

Girder supports for valve-gear

Return crank

Valve fork or cross-head

Union link

and squeeze in a pin made from 3/32-in. silver-steel. Finally, run the collars up against the inner sides of the bearings, and tighten the setscrews. The gear should reverse smoothly with the main cranks at any position.

As stated above, I have severely condensed the description of this reversing gear, because it is the same, except for minor details, as that for *Doris* which was recently described in full; but any inexperienced builder who is doubtful about ways and means of machining and fitting the components, should refer to the full instructoins given for beginners' benefit, in the description of how to build *Tich*. There is no sense in wasting valuable space in needless repetition when builders want to get on with the job. Full size blueprints of the valve gear should be available from our offices, by the time these notes appear, or very soon afterwards, and should be a great help to inexperienced workers. All being well, and circumstances and the K.B.P. permitting, the drawings and notes on fitting alternative Baker valve gear (which I should certainly fit to the full-size job, if I were C.M.E. of the S.R.) will follow as soon as ever the drawings are ready. Unfortunately, my nearly-worn-out noddle won't function quite as speedily as I would wish! It would be best to leave the valve-setting until after the wheel-and-screw reverser has been fitted, so that will be the next job.

The Chemical Colouration of Metals

by G. W. Arthur-Brand

IT often happens that the model engineer, in pursuit of scale effect finds himself up against the problem of successfully colouring metal parts which, by virtue of their functions, do not lend themselves to painting.

The processes I am about to describe have been widely used for some considerable time, and it is anticipated that they will be the means of solving many readers' problems.

At the outset, I would like to stress the importance of strict observation of the rules of cleanliness. The component to be treated should first be polished, then all traces of oil or grease removed before submerging for two or three minutes in a bath containing warm dilute hydrochloric acid. It must then be rinsed immediately in warm water, after which it will be ready for treatment. Failure to observe this preliminary operation will usually result in uneven colouring or fading, whatever process is being employed.

Age-effect on Brass and Copper

Although there is a distinct temptation to polish brass and copper parts of models regardless of the period they are deemed to represent, it is felt that this may be due very largely to a lack of knowledge regarding the process which would readily produce such an effect.

The brown or green colourations which old articles in brass or copper acquire by virtue of of their age or from long periods of exposure are quite easy to reproduce chemically. The brown patina, however, is probably the easier of the two to attain, and copper, when dipped in a dilute solution of sodium sulphide, will immediately conform to this effect, the shade and depth, of course, being dependent upon the strength of the solution and the period of submersion. On the other hand, brass may be successfully treated for a similar patina by heating in a compound of sulphur and lime.

To produce a green patina on brass and copper it will be necessary to construct a small wooden stand from which to suspend the objects. Next, prepare an airtight container, such as a large, ground-stoppered bottle with a wide mouth, by placing in the bottom a small, open receptacle containing some washing soda and a little water.

Now brush the parts to be treated with a dilute solution of acetic acid, suspend from the stand and place the latter in the airtight container over the receptacle containing the washing soda. Lastly, pour some acetic acid over the washing soda and immediately close the top of the container. The reaction caused by the formation of carbon dioxide gas evolving from the mixture in the small receptacle in conjunction with the acetic acid will cause the articles to attain a hard, shiny, yellow-green colouration.

For those desiring a somewhat less involved method of producing a similar effect, if not quite as efficient, the parts may be brushed daily with a solution comprising equal parts of sugar, vinegar and common salt, by weight.

To obtain a blue-green colouration, mix up a solution of: 8 parts strong vinegar, 3 parts copper carbonate, 1 part copper acetate, 1 part cream of tartar, 1 part sal-amoniac and 1 part common salt.

Paint the articles over daily with this solution until the required effect is obtained.

Matt-Black Surfacing

Perhaps the most useful finish of all will be matt-black, especially as it can be affected by quite simple and rapid processes.

Iron components of all sorts may be given an attractive blue-black colouration by immersion in ordinary photographer's hypo, to which has been added a small percentage of lead acetate. By boiling in a solution of hypo containing a small percentage of lead nitrate, a "blued" effect will be obtained.

Brass and copper components may be blackened in a matter of minutes by immersing in a solution of 1 oz. copper nitrate to 3 oz. water.

Finally, I have often been asked for a successful method of dyeing alluminium. This necessitates no complicated process and consists merely of dipping the material for a few seconds in a hot, medium strong solution of caustic soda, following which it is immediately rinsed in warm, running water and immersed in a hot solution of an aniline dye of the desired colour. The resultant effect is that of colour-anodic treatment, which will not flake or crack.

THE SOUTH LONDON OPEN REGATTA

THIS year's event, held at Brockwell Park, attracted a large number of entries, and representatives of many clubs took part, including the Croydon, Kingsmere, Orpington, Blackheath, Victoria, North London, Enfield and the home club. The weather was extremely good and some very high performances were put up, though there were the usual patches of bad luck, and many promising runs were not completed.

Speed

In the speed events, which were run first, the "C" class boats were the most numerous and generally the most successful. Among the unrestricted (entirely home-built) boats in this class, the favourite was a new boat *Foz*, by Mr. R. Phillips (South London), which made a splendid start at very high speed, but came to grief on the fourth lap. On the second attempt, it just managed to complete the full course before repeating the diving act, and thereby tied with Mr. B. Miles' boat, necessitating a re-run, which produced slower speeds in both cases, but gave *Foz* first place.

Mr. A. Stone (South London) easily won first place in the "C" class (restricted) with *Toots*, and Mr. Hodges (Orpington) had a walk-over in "B" class with *Sparta*. The "A" class resolved itself into a contest between ancient and modern boats, the latter represented by Mr. E. Clark (Victoria) with *Gordon* 2 putting up a fine run which won first place, while the pre-war veteran *Wasp III*, by Mr. W. Parris, came second.

Mr. E. Clark (right) starting Gordon 2, *a new "A" class boat which is still in the teething stage, but shows great promise*

Nomination and Steering

The events for prototype boats comprised a nomination race and a steering competition, the former being run on conventional lines, but a new idea was tried out in the latter, by using three targets "in series," the nearest of the three scoring lowest points, with additional points for the second and third targets. Many boats negotiated the first target successfully, but wandered off the course before reaching the second or third.

Results were as follows :—

"C" class (Unresteicted). — 1st R. Phillips (S. London), *Foz*, best speed 48.7 m.p.h., (re-run, 40.9 m.p.h.) 2nd B. Miles (Kingsmere), 48.7 m.p.h.

"C" class (Restricted).—1st A. Stone (S. London), *Toots*, 44.4 m.p.h.

"B" class.—1st N. Hodges (Orpington), *Sparta*, 39.3 m.p.h.

"A" class.—1st E. Clark (Victoria), *Gordon* 2, 48.7 m.p.h. 2nd W. Parris (S. London), *Wasp III*, 33 m.p.h.

Nomination Race.—1st F. W. Bunton (Kingsmere), error 0.2 sec. 2nd E. Vanner (Victoria), *Leda III*, error 1 sec.

Steering Competition.—1st F. Curtis (Kingsmere), 15 points. 2nd Duncan (Croydon), 13 points.

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed: "Queries Dept." THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query; but subdivision of details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered within the scope of this service.

No. 9824.—Wheel Trains for 4-in. R.B. Drummond
A.D.C. (Uckfield)

Q.—Could you give me the train of wheels for fine feed, self-act, and screw-cutting for a Drummond 4 in. round bed lathe. I have these wheels: 66, 50, 45, 40, 40, 35, 30, 26, 25, 20, 20: is this a full set?

R.—The finest feed which is readily obtainable on your Drummond lathe with the wheels and other fittings available, and without making up special attachments, is 117 turns to the inch, which can be obtained by using the three smallest wheels as drivers, and the three largest wheels as driven wheels in a double compound train. The details of the arrangement would be 20 on mandrel driving on to 45 on first stud, with 20 on first stud driving on to 50 on second stud, 25 on second stud driving on to 66 on mandrel. This particular lathe is now out of production, and we do not think it would be possible to get any information on the subject from Messrs. Drummond at the present time. Their address, however, is Rydes Hill, Guildford, Surrey.

No. 9825.—"Crystalline" Finish
F.C. (Tooting)

Q.—I am constructing a photograph enlarger, and would like to finish it with crackle enamel effect. Could you please inform me where to obtain the enamel and the name of same, as I presume it is a special kind, also how it is applied, as I think it has to be stoved, or heated in some way.

R.—Special enamels for producing a crackle finish are made by most well-known paint and enamel manufacturers. In the great majority of cases, the application of this enamel entails the necessity for stoving to produce the correct effect, and in some cases it is essential to use a gas-heated oven for this purpose, as the products of combustion play a part in producing the "crystalline" finish. We suggest that you get in touch with Messrs. W. Canning & Co. Ltd., St. Johns Street, E.C.1, who can supply a suitable enamel with the necessary instructions for its use.

No. 9826.—Calculation of I.H.P.
J.H.W. (Blackpool)

Q.—In working out the i.h.p. of a steam engine by the P.L.A.N. method, is the boiler pressure used as the power factor? What is the approximate mechanical efficiency of a well designed model steam engine? Taking 50 watts as 1/15 h.p., should a steam engine of $\frac{1}{8}$ i.h.p. drive it efficiently?

R.—For calculating the i.h.p. of an engine by the formula P.L.A.N. over 33,000, the figure *P* should represent the mean effective pressure in the cylinder calculated over the entire length of stroke. This is, in nearly all cases, considerably below the boiler pressure, but its exact value will depend on several factors, such as the point of cut-off of the slide valve, and the extent of any restriction in the supply to the receiver, or wire drawing in the ports.

It should, theoretically, be possible to obtain 50 watts by the expenditure of $\frac{1}{8}$ h.p., but the efficiency of small generators varies considerably and is rarely more than about 50 per cent., so that it is always advisable to allow an adequate margin of power in hand.

No. 9830.—The Universal Joint
T.R. (Swansea)

Q.—Would a square piece of good mild-steel bevelled off at the ends and fitted inside a proper housing be suitable as a universal joint, instead of the usual type of joint such as a cross-piece and two forks, or a grooved sphere with two forks? The square piece would allow a certain amount of movement in both planes, vertical and horizontal. I have been thinking it out and it appears to me that when a square becomes tilted it becomes a rhombus; would that have any ill effects on its suitability as a universal joint?

R.—A true universal joint must have articulated members designed in such a way that they present an adequate surface on the points of contact at any angularity within the working range. Certain types of joints which do not comply with this condition are, however, used in practice and may be satisfactory within certain limits, but they introduce friction when any

considerable angularity or misalignment is encountered, and are also subject to considerable wear under those conditions. The type of joint which embodies a spherical centre member with grooves at right angles is a true universal joint, but is only suitable for moderate loads because of the friction which takes place between the forks of the grooves. The suggested use of a square driving member does, as you suggest, allow of accommodation both in respect of angular and parallel alignment, but under these conditions the drive is only taken on points of relatively limited areas, and its efficiency would not be at all high.

No. 9831.—Welding Transformers J.M.C. (Ashford)

Q.—(1) Could you please give me particulars of a welding transformer working with 30 volts at 100 amps?

(2) Will the windings be on the opposite arms or will the primary have to go in the space between the stampings?

(3) Where could such stampings and copper wire be obtained?

R.—30 volts is too low for welding, a voltage of 60-80 is usual. A choke regulator is necessary for use, as regulation is necessary during welding because the current and voltage is different for the different sizes of welding-rods used. The respective coils are arranged on each limb and not in the window of the transformer. You will calculate the secondary turns to the same value as the primary so far as turns per volts are concerned. The secondary wire can be four 10-s.w.g. plain enamel covered wire wound four wires in parallel, or a copper strip may be used of the same sectional area. The strip would be cotton covered to two layers. Covered strip is obtainable from suppliers of winding wires. Stampings could be obtained from Messrs. Sankey & Co., Bilston, Staffs. The London Electric Wire Co. Spencer Street, W.C., would supply the wire or strip.

No. 9829.—Caliper Tips T.R. (Swansea)

Q.—I have just completed making a pair of self-registering calipers, with a graduated sector plate on the top and attached to one leg of the caliper. I have been told that the measuring points of the caliper legs must be fitted to sharp points, as if they are made with a small radius one would get a small element of error. I thought of making the points with a small radius to stand more wear, and would like your opinion on the matter, as I don't see where the error comes in.

R.—It is quite practicable to use ball points on the tips of self-registering calipers, but it is necessary to calibrate the scale from actual measurement between the tips, because at various openings, different points on the surfaces of the ball tips will make contact with the slight variation of the radial distance of contact point. This discrepancy may not be sufficient to make much difference, unless an extremely high degree of precision is required, provided the points are not made of larger radius than is considered absolutely necessary.

No. 9836.—Starting Device for "Atom V" E.C.H. (Bristol)

Q.—I have recently built an Atom "V" engine and I should like your help regarding the ratchet starter spring. I find 18 s.w.g. more satisfactory than 16 s.w.g., but I am unable to get the outer end of spring to remain anchored. I use about four turns of cord and think that if I shorten this so that the turn of engine is limited by cord, not spring, my trouble may be overcome, but I shall probably have to sacrifice some of my $1\frac{3}{4}$ engine turns, which I am loath to do.

R.—It has been found in practice that 17 s.w.g. piano wire is the most satisfactory size for the re-wind spring. The length of the cord should always be limited, so that the full strain cannot come on the spring at the end of the pull. Incidentally, it is not generally desirable to use cord starting-gear until the engine has been thoroughly run in, as the strain on the gear is abnormal when the engine is on the tight side. In actual practice, it is found fairly satisfactory to be able to turn the engine over about $1\frac{1}{2}$ turns.

No. 9839.—Spot Welding C.W. (Nigeria)

Q.—Would you please advise me as to how the negative and positive leads are joined or conducted to the materials to be welded?

R.—It is not usual to connect the electric supply to the work at all in this process, but to the two electrodes which are brought in contact with the work at the point to be welded. The tips of the electrodes are made of a material which will not weld or fuse to the metal, but sufficient heat is generated at this point to weld two pieces of metal to each other.

No. 9834.—Intermittent Movements F.R.R. (Belfast)

Q.—I have recently built a 16 mm. film projector using a form of optical compensation (rotating prism, 4-sided) and the machine functions fairly well in my own home. I now want to build one which I can use in a rather poorly blacked-out school hall with a throw of 50ft. My projector does not give sufficiently powerful illumination, and I am under the impression that the use of intermittent mechanism will allow more light to reach the screen. I am interested in the "beater-roller" mechanism, as it appears to me to be the easiest to make with a simple lathe.

R.—It is a very common fallacy that the "beater-roller" mechanism for shifting film is easier to construct than a claw or other type of intermittent motion. The fact is that, although the roller and crank mechanism itself is very easy to make, the success of the mechanism depends entirely on extremely high accuracy of the take-up sprocket, as it is this which really locates the film frame in position. Many of the cheap cinemas which have been fitted with beater mechanism have not been highly satisfactory, particularly when there has been any wear and tear of the film perforations, and the impact produced by this mechanism tends to be rather heavy on the films.